Supplemental Information Report

March 1996

American River Watershed Project, California

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Part I Main Report
Part II Final Supplemental Environmental Impact Statement / Environmental Impact Report

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US Army Corps of Engineers
Sacramento District

The Reclamation Board
State of California

SAFCA
Sacramento Area Flood Control Agency

American River Watershed Project, California

Part I Main Report
Part II Final Supplemental Environmental Impact Statement / Environmental Impact Report

March 1996

EXECUTIVE SUMMARY

This report supplements the December 1991 feasibility report for the American River Watershed Investigation. Specifically, it:

- Reassesses the risk to the Sacramento area of flooding from the American River
- Reassesses individual flood protection measures to reduce the risk
- Describes a range of alternatives, including combinations of individual measures, to increase flood protection to Sacramento
- Presents three candidate flood protection plans
- Identifies from the candidate plans the locally preferred plan, which is also the Federal "selected plan"
- Outlines the process for implementing the selected plan and important future actions

This report has two parts: a main report, which focuses on the flood protection alternatives, and a supplemental environmental impact statement/environmental impact report. The report was requested by Congress and reflects information and comments from extensive review by both the public and governmental agencies.

BACKGROUND

In February 1986, the "storm of record" in the American River basin strained the flood control system that protects Sacramento, the capital of California. Studies showed that the Sacramento area has a very modest level of protection—substantially below even the 100-year threshold for the national flood insurance program.

These studies culminated in the American River Watershed Investigation Feasibility Report, which recommended construction of levee and related improvements in the Natomas area of Sacramento and a flood detention dam on the North Fork American River upstream from Folsom Reservoir. Congress in 1992 authorized construction of the Natomas portion of the recommended plan and requested additional information on the flood detention dam and other flood protection measures for the main stem of the American River.

FLOOD PROBLEM

Folsom Dam and Reservoir, located about 29 miles upstream from Sacramento, are key features in the flood control system protecting the capital city. Folsom Reservoir has a capacity of 975,000 acre-feet, which includes a minimum of 400,000 acre-feet of space seasonally dedicated to flood control. Releases from Folsom Reservoir course through the Sacramento area in a system of flood control levees. The "objective release," or maximum sustainable controlled flood release, is 115,000 cfs (cubic feet per second).

The levees along the American River downstream from Folsom Dam are likely to fail at various locations when flows reach between 130,000 and 160,000 cfs or equivalent water-surface elevations. The risk of levee failure from a 100-year storm is about 60 percent, assuming interim reoperation of Folsom Dam and Reservoir as recently negotiated between the Sacramento Area Flood Control Agency and the U.S. Bureau of Reclamation, which operates Folsom. The agreement increases the flood space in Folsom from 400,000 acre-feet to a space varying from 400,000 acre-feet to 670,000 acre-feet, which increases Sacramento's protection to about the 100-year level.

Levee failure along the lower American River could result in flooding of more than 100,000 acres. Many of the more than 400,000 residents in the flood plain would be affected. Damages would range from $7 billion from flooding from a 100-year storm to more than $16 billion for a 400-year storm.

Flooding would result in loss of lives, mainly drownings from rapid inundation of the flood plain, and other impacts on public health and safety once the floodwaters recede. Damages from toxic and hazardous waste contamination would be extensive, and environmental resources would be lost in the flood plain and elsewhere as materials are used to reconstruct damaged property. Disruptions to commercial and governmental activities and to transportation routes would be significant.

FLOOD CONTROL MEASURES AND INITIAL ALTERNATIVES

Seventeen individual flood protection measures were evaluated for Sacramento. Of these, the following seven were included in an initial array of flood protection alternatives:

- Lower the main spillway at Folsom Dam
- Enlarge the eight existing river outlets in Folsom Dam
- Construct new river outlets in Folsom Dam
- Modify the levees along the lower American River to accommodate higher flood releases from Folsom Reservoir
- Increase the seasonal flood control storage space in Folsom Reservoir
- Increase the surcharge storage in Folsom Reservoir
- Build a flood detention dam on the North Fork American River

Alternatives formulated from the these measures can substantially increase Sacramento's flood protection. Increasing the seasonal flood space and surcharge storage in Folsom Reservoir together with lowering the spillway and enlarging the river outlets would increase flood protection to nearly the 200-year level. These changes plus levee work downstream to accommodate larger flood releases from Folsom Dam would increase the level to about 300 years. Higher levels are possible only with additional flood storage upstream from Folsom Reservoir.

Eight representative alternatives were formulated from the measures and are summarized in table 1. In addition to the primary features shown in the table, each alternative also includes modifications to the Sacramento River levee at Natomas downstream from the Natomas Cross Canal.

The alternatives listed in table 1 were included in a November 1994 Alternatives Report and were coordinated with The Reclamation Board of the State of California and SAFCA, the non-Federal sponsors for the American River studies. From these eight alternatives and the results of public and agency comments, three candidate plans were formulated.

NO-ACTION ALTERNATIVE AND CANDIDATE PLANS

Following a series of public workshops and hearings completed in February 1995, The Reclamation Board and SAFCA selected two plans to be evaluated in detail—the Detention Dam Plan and the Folsom Stepped Release Plan. The Corps included a third plan—the Folsom Modification Plan—which together with the No-Action Alternative make up the final array of candidate plans.

Table 2 compares the No-Action Alternative and the accomplishments, major features, and estimated costs and benefits of the three candidate "action" plans. These plans and the No-Action Alternative are summarized below.

No-Action Alternative

As part of the No-Action Alternative, the current reoperation of Folsom Dam and Reservoir would be extended indefinitely. The Federal Government would take no further action toward implementing a specific flood protection plan for Sacramento, and the flood threat that exists today would not be lessened. The Reclamation Board and SAFCA have indicated that Sacramento requires at least a 200-year level of protection. The chance that the current flood control system could pass a 200-year storm without levee failure and major flooding in Sacramento is about 16 percent.

Folsom Modification Plan

This plan was designed to minimize project construction and operation impacts on environmental resources. The plan would reduce the probability of flooding due to levee failure to 1 chance in 180 in any one year and have about a 54 percent chance of safely passing a 200-year storm. The major features of this plan are:

- Increasing the flood storage in Folsom Reservoir to a space varying from 475,000 to 720,000 acre-feet

TABLE 1

Summary of Initial Flood Protection Alternatives

Alternative	Primary Features	Flood Protection [1]
Minimum Impact	Increase flood control space, surcharge space, and outlet capacity at Folsom with no change in objective release and downstream channel capacity (115,000 cfs)	1 in 160
Minimum Objective Release	Increase flood control space, surcharge space, and outlet capacity at Folsom with a minor increase in objective release and downstream channel capacity (130,000 cfs)	1 in 200
Moderate Objective Release	Increase flood control space, surcharge space, and outlet capacity at Folsom with a moderate increase in objective release and downstream channel capacity (145,000 cfs)	1 in 240
Maximum Objective Release	Increase flood control space, surcharge space, and outlet capacity at Folsom with a major increase in objective release and downstream channel capacity (180,000 cfs)	1 in 300
Stepped Release Plan	Increase surcharge space and outlet capacity at Folsom with a major increase in objective release and downstream channel capacity (145,000 to 180,000 cfs)	1 in 235
200-Year Storage	380,000-acre-foot flood detention dam upstream from Folsom Reservoir	1 in 200
Equivalent Storage	545,000-acre-foot flood detention dam upstream from Folsom Reservoir	1 in 270
Feasibility Report NED	894,000-acre-foot flood detention dam upstream from Folsom Reservoir	1 in 435

[1] Chance of flooding in any one year.

TABLE 2

Summary Comparison of No Action and Candidate Plans

Item	Alternative			
	No-Action Alternative	**Folsom Modification Plan**	**Folsom Stepped Release Plan**	**Detention Dam Plan**
Level of flood protection (probability of flooding in any one year)	1 in 100	1 in 180	1 in 235	less than 1 in 500
Reduction in flood protection (%)	-	43	49	79
Probability of passing a 200-year storm (%)	16	54	68	97
Features				
Folsom Dam & Reservoir				
Flood control space (ac-ft)	400,000/670,000	475,000/720,000	400,000/670,000	400,000
Maximum objective release (cfs)	115,000	115,000	145,000/180,000	115,000
Lower main spillway 15 feet	No	Yes	Yes	No
Outlets (No. of gates & capacity, cfs)	8 at 30,000	8 at 70,000	8 at 70,000	8 at 30,000
Modify surcharge storage	No	Yes	Yes	No
Lower American River				
Stabilize/modify levees (mi)	0	24	29	24
Raise/replace bridges	0	0	3	0
Recreation trails & park areas (acres)	0	0	13	0
Environmental restoration areas (acres)	0	0	103	0
Downstream American River				
Modify Sacramento River levees (mi)	0	12	12	12
Modify Sacramento Weir & Bypass (ft)	0	0	1,000	0
Modify Yolo Bypass levees (mi)	0	0	52	0
Upstream Storage				
Detention space (ac-ft)	0	0	0	894,000
Dam height (ft)	0	0	0	508
Flood operation gates	0	0	0	20
Bridge relocations	0	0	0	2
Benefit Comparison - Without-Project Condition (with Folsom reoperation to 400,000/670,000) [1]				
Costs ($ million)				
First cost	-	399	522	949
Annual cost	-	44	64	95
Annual benefits ($ million)	-	98	102	186
Net annual benefits ($ million)	-	54	38	91
Benefit Comparison - Baseline Condition (before reoperation) [2]				
Cost ($ million) [3]				
First cost	-	469	627	949
Annual cost	-	49	73	95
Annual benefit ($ million) [3]	-	126	129	206
Net annual benefits ($ million) [3]	-	77	56	111

[1] The current reoperation of Folsom Dam and Reservoir would continue indefinitely under the No-Action Alternative (without-project condition) and so the costs are assumed to also continue with both the Folsom Modification and Folsom Stepped Release Plans. The costs associated with this reoperation level are being paid by SAFCA, so they are not included in this table.

[2] Includes costs and benefits associated with adopting permanent reoperation in Folsom Modification and Stepped Release Plans.

[3] Change from without-project condition reflects costs (Folsom Modification and Folsom Stepped Release Plans) and benefit Reduction (Detention Dam Plan) for permanent reoperation of Folsom from 400,000 acre-feet to 400,000/670,000 acre-feet (and reversed for the dam).

- Lowering the main spillway at Folsom Dam by 15 feet, replacing the main-spillway gates, and enlarging the eight existing river outlets

- Modifying the use of surcharge storage space in Folsom Reservoir, which would require (1) replacing the auxiliary-spillway gates and (2) strengthening embankments and dikes at Folsom to accommodate higher water-surface elevations in the reservoir

- Constructing a slurry wall in about 24 miles of existing levees along the lower American River

- Strengthening and raising about 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River

This plan would reduce water-supply capacity and hydropower benefits at Folsom Reservoir as a result of a permanent increase in the seasonal flood control space. Some environmental resources at the reservoir and along the lower American River would be adversely affected. Table 3 summarizes the major impacts and mitigation to offset them.

This plan is cost effective—it would provide about $2.20 in benefits for each $1 spent. The construction, or first, cost of this plan is significantly lower than the two other plans, and the plan would require significantly less work than the other plans to mitigate adverse impacts on environmental resources. It would moderately increase flood protection to Sacramento and substantially increase protection to the Natomas area.

The downside to this plan is the relatively small increase in flood protection for Sacramento. The residual flood threat and attendant risk to public health and safety and environmental resources would be significant. This plan also could exacerbate future shortages in the region of water supplies and power resulting from the additional storage space in Folsom Reservoir dedicated to flood control.

Both the Folsom Modification and Folsom Stepped Release Plans presume an indefinite extension of the current reoperation of Folsom Reservoir. (The Folsom Modification Plan would increase reoperation even beyond the current level.) It is likely that the cost to mitigate for the impacts of the permanent reoperation increment would be included as a Federal project element if either of these plans were selected for implementation. This cost for permanent reoperation (initial increment) is shown in table 2.

Folsom Stepped Release Plan

This alternative was formulated to provide at least the 200-year protection goal identified by SAFCA and The Reclamation Board, but without new upstream storage. It focuses on Folsom Dam and Reservoir operations, with no further increase in seasonal flood space in Folsom, and on measures to increase the objective release from the dam. This plan would reduce the probability of flooding to 1 chance in 235 in any year and have about a 68 percent chance of safely passing a 200-year storm.

TABLE 3

Summary of Significant Impacts and Mitigation Folsom Modification Plan

Resource	Impact	Mitigation
Fisheries	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Endangered species	Possible impacts to Swainson's hawk nesting habitat.	Require adherence to DFG guidelines.
Cultural resources	Construction activities would affect culturally sensitive areas in Folsom Reservoir.	Determine eligibility of site for inclusion in National Register and identify additional sensitive areas for study.
Water quality	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Recreation	Levee modification work along lower American River would disrupt use of bike trail. Lower water-surface elevations would reduce availability of boat launching facilities at Folsom Reservoir.	Route trail around construction areas using detours to surface streets. Extend low-water boat ramps as required.
Traffic and transportation	Levee raising and modification work along the west levee of Natomas would have temporary impacts during construction.	Reroute Garden Highway traffic to avoid construction areas.
Air quality	Construction equipment and activities would result in emissions and dust.	Require equipment to be operated in accordance with contract specifications. Design and implement a dust suppression program.
Noise	Construction work at Folsom Dam and levee modification work along the lower American River and downstream would cause temporary noise impacts.	Require equipment to be operated in accordance with contract specifications.

Other combinations of measures can provide the minimum 200-year protection more cost effectively. However, each combination includes features that would either further affect operation of the Central Valley Project or require greater changes to the existing flood control system downstream from the American River. The major features in this plan were selected to minimize these impacts or changes. They are:

- Continuing the variable flood control storage at Folsom Dam and Reservoir of 400,000 to 670,000 acre-feet

- Lowering the main spillway at Folsom Dam by 15 feet, replacing the main-spillway gates, and enlarging eight existing outlets

- Modifying the use of surcharge storage space in Folsom Reservoir, which would require (1) replacing the auxiliary-spillway gates and (2) strengthening embankments and dikes at Folsom to accommodate higher water-surface elevations in the reservoir

- Increasing the objective release from Folsom Dam to 145,000 cfs and 180,000 cfs, depending on reservoir inflow and storage

- Constructing levee, channel, and other improvements, including a slurry wall, along the lower American River to handle the increased objective release

- Lengthening the Sacramento Weir, widening the Sacramento Bypass, and raising or modifying levees at various locations along the Yolo Bypass to accommodate the increased objective release

- Strengthening and raising about 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River

- Constructing recreation facilities and environmental restoration features in the American River Parkway

This plan would have some adverse environmental effects at Folsom Reservoir and along the lower river. Table 4 summarizes the significant impacts and mitigation to offset them.

This plan would provide a fairly high level of flood protection to Sacramento and the Natomas area with minimal environmental impacts from project construction and operation. Each plan feature incrementally increases the level of flood protection. This plan would cost considerably more than the Folsom Modification Plan but substantially less than the Detention Dam Plan.

Because this plan would increase the objective release from Folsom Dam to as much as 180,000 cfs, it would require extensive work on levees, bypasses, and related features downstream from the American River to handle these higher flows. But even with these improvements, concerns would remain about such high releases.

The non-Federal share of this plan would be 71 percent of the total cost. Several major features of the plan, including downstream levee improvements, are not incrementally justified, so they would have to be paid by non-Federal interests. Despite the features that are not incrementally justified, the overall plan is economically feasible.

Like the Folsom Modification Plan, the Stepped Release Plan does not include the cost of the initial increment of Folsom reoperation. However, the additional costs and benefits are shown in table 2.

TABLE 4

Summary of Significant Impacts and Mitigation
Stepped Release Plan

Resource	Impact	Mitigation
Fisheries	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Vegetation and wildlife	Loss of 37 acres of riparian and upland habitats along lower American River. Loss of 120 acres of wetland, riparian, and upland habitats in Sacramento and Yolo Bypasses.	Create 113 acres of replacement habitat at borrow areas along lower American River. Create 116 acres of replacement habitat at Liberty Island.
Endangered species	Loss of 137 elderberry shrubs due to levee modification. Possible effect on Swainson's hawk nesting habitat. Possible effect on giant garter snake resulting from construction.	Replace shrubs lost at a 3:1 ratio in mitigation areas. Require adherence to DFG guidelines. Require adherence to DFG guidelines.
Cultural resources	Construction activities would affect culturally sensitive areas along lower American River.	Determine eligibility of site for inclusion in National Register and identify additional sensitive areas for study.
Water quality	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Visual resources	Levee construction work along lower American River would have permanent impacts.	Unmitigable, unavoidable impact.
Recreation	Levee modification work along lower American River would disrupt use of bike trail. Creation of new bike trail, Gateway and 7th Street parks.	Route trail around construction areas using detours to surface streets. Would benefit recreational resources.
Traffic and transportation	Levee raising and modification work along the west levee of Natomas would have temporary impacts during construction.	Reroute Garden Highway traffic to avoid construction areas.
Air quality	Construction equipment and activities would result in emissions and dust.	Require equipment to be operated in accordance with contract specifications. Design and implement a dust suppression program.
Hazardous and toxic waste	A dump site is located in the area where the Sacramento Bypass levee would be moved 1,000 feet to the north. There are no other HTRW sites known in the construction area.	Excavate the contents of this site and move to the landfill north of Davis.
Noise	Construction work at Folsom Dam and levee modification work along the lower American River and downstream would cause temporary noise impacts.	Require equipment to be operated in accordance with contract specifications.

Detention Dam Plan

The detention dam would reduce the probability of flooding to less than 1 chance in 500 in any year and have about a 97 percent chance of safely passing the 200-year storm. The major features of this plan are:

- Constructing a 508-foot-high flood detention dam on the North Fork American River to create a detention capacity of 894,000 acre-feet

- Constructing a slurry wall in about 24 miles of existing levees along the lower American River

- Strengthening and raising about 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River

- Changing the flood control operation of Folsom Reservoir to the prereoperation (pre-1995) flood space of 400,000 acre-feet

This plan would provide the highest level of flood protection to the Sacramento area. It would also have a beneficial effect on water supplies and hydropower generation of the Federal Central Valley Project by restoring the flood control operation of Folsom Reservoir to 400,000 acre-feet of seasonal storage space. Table 5 summarizes the significant environmental impacts of the plan and mitigation to offset them.

The detention dam would provide a very high level of flood protection to Sacramento and the Natomas area and reduce the chance of levee failure along the lower Sacramento River. It also would contribute to the availability of water and power supplies in the region by recapturing those benefits forgone by reoperation of Folsom Dam and Reservoir for additional flood protection. The objective release from Folsom Dam would be maintained at 115,000 cfs, so levee and related improvements would not be required in the Sacramento and Yolo Bypasses.

Of the three plans, the detention plan has the highest construction cost. However, it also produces the greatest net economic benefits. This plan maximizes the Federal objective for national economic development (NED) consistent with protecting the Nation's environment. Past proposals to build a detention dam have been contentious—supported by those committed to a very high level of flood protection for Sacramento and opposed by others focused on protection of the environmental resources of the American River canyon.

PLAN SELECTION

The candidate plans were reviewed at a series of public hearings on the draft SIR in October and November 1995. After the hearings, The Reclamation Board, the non-Federal

TABLE 5

Summary of Significant Impacts and Mitigation
Detention Dam Plan

Resource	Impact	Mitigation
Fisheries	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches.
Vegetation and wildlife	Construction of dam and relocation of Highway 49 would eliminate 313 acres of riparian and upland habitats. Operation of detention dam would eliminate 1,369 acres of riparian and upland habitats.	Implement adaptive management plan. Plant 4,443 acres of replacement habitat at inundation area (1,481 acres) and Yuba River area (2,962 acres).
Endangered species	Loss of approximately 103 elderberry shrubs from periodic inundation of 210 shrubs (73 with exit holes). Possible impacts to Swainson's hawk nesting habitat. Possible effect on giant garter snake resulting from construction.	Plant total of 7,008 seedlings at various areas along Middle Fork American River. Require adherence to DFG guidelines. Require adherence to DFG guidelines.
Cultural resources	Construction and operation would affect 180 known historic and prehistoric sites in the American River canyon.	Determine eligibility of sites for inclusion in National Register and identify additional sensitive areas for study. Complete inventory and investigation process and determination of eligibility.
Water quality	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work adjacent to river during dry season.
Air quality	Construction equipment and activities would result in emissions and dust.	Require equipment to be operated in accordance with contract specifications. Design and implement a dust suppression program.
Recreation	Levee modification work along lower American River would disrupt use of bike trail. Operation of detention dam would flood facilities at Lake Clementine. Recreation trails and access areas in detention area may be damaged during inundation.	Route trail around construction areas using detours to surface streets. Flood proof or remove facilities before storms. Offset damage to the trail system through vegetation management under the Adaptive Management Plan, which includes some repair of trails following floods.
Visual resources	Aggregate extraction, transport, and concrete-mixing activities would alter the viewshed. Construction of the dam would create a 508-foot-high structure in the canyon, and relocation of Highway 49 would create new, permanent obstructions to the viewshed.	Remove the extraction and mixing equipment and restore the area using native vegetation. Unmitigable, unavoidable impact.
Traffic and transportation	Levee modification work along the west levee of Natomas would have temporary impacts during construction. Probable effects from Highway 49 construction.	Reroute Garden Highway traffic to avoid construction areas. Develop mitigation plan.

project sponsor, chose the Detention Dam Plan as the locally preferred flood protection plan. The SAFCA Board of Directors supported this plan choice in November 1995. Accordingly, and because it is the plan that maximizes net NED benefits, the Detention Dam Plan was selected for recommended implementation in final SIR.

SELECTED PLAN

Accomplishments

In conjunction with Folsom Reservoir and other existing flood control facilities, the Detention Dam Plan would provide these accomplishments:

Lower American River

- Increase in the level of protection from a 1 in 100 chance to less than a 1 in 500 chance of flooding in any year.
- Reduce the chance of flooding over a 50-year period from 40 percent to less than 8 percent.
- Reduce the average annual flood damages in Sacramento by about 80 percent.
- Restore water, power, and recreation resources forgone due to interim reoperation of Folsom Dam and Reservoir.

Natomas Area. Increase in the level of flood protection in the Natomas area from a 1 in 150 chance to about a 1 in 400 chance of flooding in any year.

Lower Sacramento River. Decrease the likelihood of levee failure along the lower Sacramento River by about 90 percent.

Components

Primary features of the Detention Dam Plan are shown on plate I and are summarized below:

Detention Dam Area

- Construct a concrete gravity dam 508 feet high with a detention capacity of 894,000 acre-feet on the North Fork American River near Auburn.
- Acquire about 6,000 acres of land (primary in flowage easement) in the detention area.

- Relocate State Highway 49 and modify the Ponderosa Way Bridge in the detention area.

- Acquire and restore 2,960 acres of degraded habitat in the Yuba River basin to partially mitigate for impacts to riparian and upland habitat.

- Implement an adaptive management plan in the detention area to restore any remaining losses to wildlife habitat not mitigated by the Yuba River management area. The adaptive management plan would also restore roads and recreation trails within the project boundaries as needed to monitor and implement the mitigation plantings. About 7,008 elderberry seedlings would be planted to mitigate possible impacts to the threatened valley elderberry longhorn beetle.

Folsom Dam and Reservoir. Return the flood control operation at Folsom Reservoir to a maximum seasonal space of 400,000 acre-feet. This would restore full benefits to water supply, hydropower, and recreation forgone due to interim reoperation.

Telemeter Upstream Inflow Gages and Emergency Flood Warning System. Install three telemetered gaging stations upstream from Folsom Reservoir to enhance real-time flood operation during a storm. Implement an improved automated flood-warning system along the lower American River.

Lower American River and Downstream. Construct approximately 24 miles of slurry wall in the center of existing levees.

Natomas. Raise about 10 miles and strengthen 12 miles of levees on the east side of the Sacramento River downstream from the Natomas Cross Canal.

Benefits and Costs

The first cost of the selected plan is estimated at $949 million (October 1995 price levels). This includes a portion of the costs incurred by the Bureau of Reclamation on the multipurpose Auburn Dam project. The total annual costs are estimated at $95 million. The average annual equivalent benefits (at a rate of 7⅝ percent) are estimated at about $186 million, yielding a benefit-to-cost ratio of 1.9 to 1.0. Table 6 shows the first and annual costs and benefits of the plan, and table 7 shows how these costs would be apportioned between the Federal Government and non-Federal project sponsor.

SCHEDULE

The schedule for this report and resultant project is:

February 1996	Final Supplemental Information Report to Washington-level review
Fall 1996	Congressional authorization
2000 - 2007	Project construction

TABLE 6

Selected Plan - Cost Estimate [1]
($ million)

Item	Total Previously Expended Thru FY 96	Detention Dam Area	Lower American River	Natomas Area	Total
First Cost					
Lands and management		45.2	2.0	1.5	48.7
Roads and relocations		104.3	0.0	0.0	104.3
Dam & reservoir		512.0	0.0	0.0	512.0
Levee modifications		0.0	31.1	9.3	40.4
Cultural resources		6.7	0.3	0.1	7.1
Environmental mitigation [2]		15.0	0.0	0.0	15.0
E, D, S, and A [3]	15.0	106.0	10.5	2.1	118.5
Subtotal	15.0	789.1	43.9	13.0	861.0
Creditable expenditures to date [4]	.0	87.7	0.0	0.0	87.7
Total	15.0	876.8	43.9	13.0	948.7
Investment Cost					
First Cost	15.0	876.8	43.9	13.0	948.7
Creditable expenditures to date [4]		-87.7	0.0	0.0	-87.7
Interest during construction [5]	19.9	303.6	29.3	11.2	364.0
Total	34.9	1092.7	73.2	24.2	1225.0
Annual Cost [6]					
Interest and amortization	2.7	83.4	5.6	1.8	93.5
Operation and maintenance	0.0	1.8	.0	0.0	1.8
Total	2.7	85.2	5.6	1.8	95.3
Annual Benefits					185.8
Net Annual Benefits					90.5
Benefit-Cost Ratio					1.9

[1] October 1995 price levels.
[2] Does not include lands.
[3] Engineering, design, supervision, and administration.
[4] Included in cost apportionment but not economic analysis.
[5] Includes interest on construction expenditures until project year which is 2007.
[6] Investment cost with 100-year economic project life, and 7⅝ percent interest rate.

TABLE 7

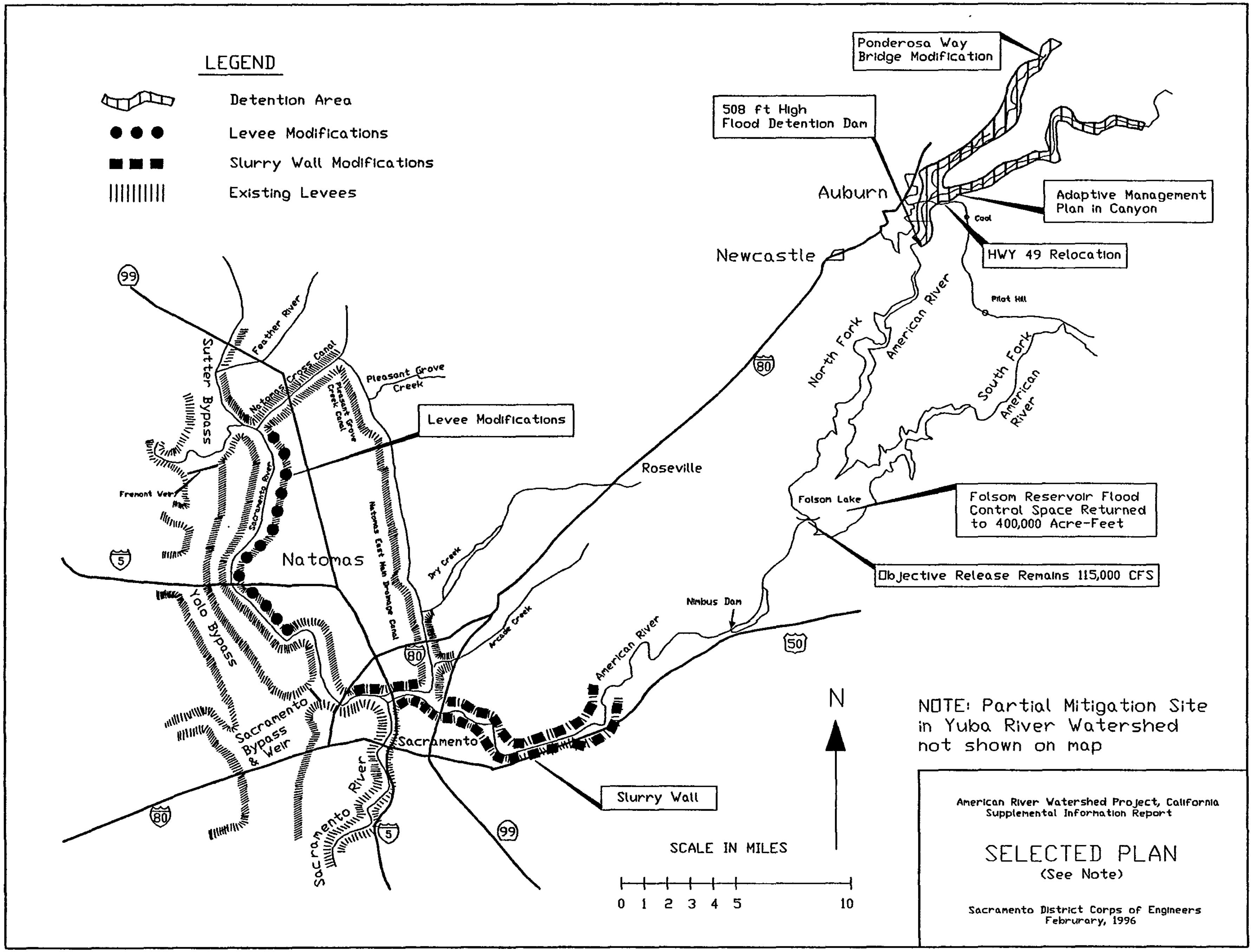
Selected Plan - Cost Apportionment [1]
($ 1000)

Item	Federal	Non-Federal	Total
First Cost			
Lands and damages	160	35,990	36,150
Relocations	180	104,080	104,260
Construction	567,420	0	567,420
Cultural resources	7,100	0	7,100
Environmental mitigation	180	12,350	12,530
Creditable expenditures to date [2]	87,700	0	87,700
E, D, S, and I [3]	113,600	19,940	133,540
Subtotal	776,340	172,360	948,700
Cash adjustment	-64,815	64,815	
Total	711,525	237,175	
Percent of first cost	75	25	

[1] 1995 price levels.

[2] Creditable expenditures to date include some of the costs plus interest incurred by USBR at the Auburn Dam site applicable to a flood detention dam.

[3] E, D, S, and I: Engineering, design, supervision, and inspection.



Executive Summary plate I

American River Watershed Project, California

Part I

MAIN REPORT

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ACRONYMS AND ABBREVIATIONS

ac-ft	acre-feet
ARFCP	American River Flood Control Project
ARWI	American River Watershed Investigation
ARWRI	American River Water Resources Investigation
ASA(CW)	Assistant Secretary of the Army (Civil Works)
avg	average
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	cubic feet per second
CSUS	California State University, Sacramento
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DFG	California Department of Fish and Game
SEIS/SEIR	supplemental environmental impact statement/supplemental environmental impact report
DSOD	California Division of Safety of Dams
DWR	California Department of Water Resources
EA	environmental assessment
E, D, S, and A	engineering, design, supervision, and administration
EIR	environmental impact report
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
ft	feet
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
g	acceleration in gravity
GWh	gigawatthour
HCP	habitat conservation plan
IDC	interest during construction
KWh	kilowatthour
LF	linear feet
MCACES	microcomputer-aided cost estimating system
mi	mile
M&I	municipal and industrial
mo	month
msl	mean sea level
MW	megawatt
NCC	Natomas Cross Canal
NED	national economic development
NEMDC	Natomas East Main Drainage Canal
NEPA	National Environmental Policy Act

NGVD	national geodetic vertical datum
NWSRS	National Wild and Scenic Rivers System
OES	Office of Emergency Services
O&M	operation and maintenance
OMR&R	operation, maintenance, rehabilitation, and replacement
PA	public address
PCWA	Placer County Water Agency
PFP	probable failure point
PGCC	Pleasant Grove Creek Canal
pH	hydrogen-ion concentration
PMF	probable maximum flood
PNP	probable nonfailure point
PROSIM	PROject SIMulation
RDF	reservoir design flood
R&U	risk and uncertainty
SAFCA	Sacramento Area Flood Control Agency
SIR	Supplemental Information Report
SMUD	Sacramento Municipal Utility District
SPF	standard project flood
SPRR	Southern Pacific Railroad
SRFCP	Sacramento River Flood Control Project
SWP	State Water Project
UPRR	Union Pacific Railroad
WAPA	Western Area Power Administration
yr	year

CHAPTER I

INTRODUCTION

PURPOSE AND SCOPE

This report is to identify a plan that can be implemented to significantly increase the level of flood protection for much of the Sacramento area from the American River. It responds to direction provided by Congress in the Fiscal Year 1993 Defense Appropriations Act (FY 93 DoD Act) to supplement the information presented in the December 1991 feasibility report on the American River Watershed Investigation, California.

Congress asked for additional information on several flood control alternatives to the plan selected in the 1991 feasibility report, which was a flood detention dam on the North Fork American River upstream from Folsom Reservoir. These alternatives include higher flood control releases from Folsom Dam, use of existing upstream reservoirs, and operational and structural modifications to Folsom Dam and Reservoir. The report concentrates on flood control for Sacramento and is not meant to address a multipurpose water supply project. This report also addresses a number of changed conditions and new alternatives developed since completion of the feasibility report.

This report:

- Reviews significant assumptions, alternatives, conclusions, and recommendations made in the 1991 feasibility report.
- Discusses significant changes, since completion of the feasibility report, to baseline conditions which influence the formulation of acceptable and effective alternative flood protection plans.
- Describes additional studies and their results in compliance with the guidance in and resulting from the FY 1993 Appropriations Act.
- Reevaluates and revises alternative plans to reflect the results of the additional studies.
- Displays a revised array of alternative plans, three candidate plans, and a selected plan.
- Describes actions required to implement the selected plan for increasing the level of protection to Sacramento.

Sacramento is located at the mouth of the American River where it joins the Sacramento River. The American River watershed, or drainage basin, covers about 2,100 square miles northeast of Sacramento and includes portions of Placer, El Dorado, and Sacramento Counties. (See plate 1.) Runoff from this basin flows through Sacramento in a system of levees after passing through Folsom Reservoir. Folsom Dam and Reservoir are part of the Federal CVP (Central Valley Project), California's largest water delivery system. Any flood protection project built in the American River basin will have direct impacts not only in the immediate vicinity of Sacramento but potentially also from Shasta Reservoir on the Sacramento River in the north to the Sacramento-San Joaquin Delta in the south.

BACKGROUND

1986 FLOOD

In February 1986, major storms in northern California caused record floodflows in the American River basin. Outflows from Folsom Reservoir, together with high flows in the Sacramento River, caused water levels to rise above the design freeboard, or safety margin, of levees protecting the Sacramento area. Emergency repair work was required at several locations along the Garden Highway and in the Pocket area of Sacramento. Had these storms lasted much longer, major sections of levee likely would have failed, causing probable loss of life and billions of dollars in damages. The effects of the February storms raised concerns over the adequacy of the existing flood control system, which led to a series of investigations of the need to provide additional protection to Sacramento.

AMERICAN RIVER WATERSHED INVESTIGATION

The Corps completed a reconnaissance study in January 1988. The study concluded that (1) serious flood problems confront the Sacramento area, (2) economically feasible solutions are available to reduce these problems, and (3) a feasibility-level investigation was warranted. Accordingly, a feasibility study was conducted for the main stem American River and the Natomas basin. Natomas is just north of downtown Sacramento at the confluence of the lower American and Sacramento Rivers.

The scope of study was to define the flood risks to the Sacramento area and to develop flood protection alternatives consistent with other water resource needs and opportunities in the study area. The feasibility report was completed in December 1991 and recommended construction of a flood detention dam on the North Fork American River and levee improvements in the Natomas area sufficient to control runoff from a 200-year storm.

The feasibility report presented six "action" alternatives, briefly described below. Three of these would have provided protection from a 100-year storm, while the other three

would have controlled runoff from 150-year, 200-year, and 400-year storms. A no-action alternative served as the baseline for evaluating the action alternatives.

- <u>100-Year Protection - Levees</u>. This plan included (1) increasing the "objective release" (maximum controlled flood release) from Folsom Dam from 115,000 cfs (cubic feet per second) to 145,000 cfs; (2) modifying levees along the lower American River to accommodate this higher release; (3) lengthening the Sacramento Weir, widening the Sacramento Bypass, and raising levees along the Yolo Bypass to accommodate the higher release; and (4) constructing levee, channel, and related flood control improvements around Natomas.

- <u>100-Year Protection - Storage</u>. This plan included (1) increasing the maximum seasonal flood control storage space in Folsom Reservoir from 400,000 acre-feet to 590,000 acre-feet and (2) constructing improvements around Natomas.

- <u>100-Year Protection - Levees/Storage and Spillway</u>. This plan combined (1) increasing the flood control space in Folsom Reservoir from 400,000 acre-feet to 470,000 acre-feet; (2) lowering the Folsom Dam spillway 15 feet; (3) increasing the objective release from 115,000 cfs to 130,000 cfs; (4) modifying levees and channels along the lower American River, Sacramento Weir, and Sacramento and Yolo Bypasses to accommodate the higher release; and (5) constructing improvements around Natomas.

- <u>150-Year Protection</u>. This plan combined (1) increasing the flood control space in Folsom from 400,000 acre-feet to 650,000 acre-feet; (2) lowering the Folsom Dam spillway 15 feet; (3) increasing the objective release from 115,000 cfs to 180,000 cfs; (4) modifying levees and channels along the lower American River, Sacramento Weir, and Sacramento and Yolo Bypasses to accommodate the higher release; and (5) constructing improvements around Natomas.

- <u>200-Year Protection</u>. This plan included (1) constructing a flood detention dam 425 feet high on the North Fork American River near Auburn to create a detention capacity of 545,000 acre-feet and (2) constructing improvements around Natomas.

- <u>400-Year Protection</u>. This plan was similar to the 200-year plan except the dam would be 498 feet high and the detention area 894,000 acre-feet. It also included improvements around Natomas.

The Reclamation Board and SAFCA (Sacramento Area Flood Control Agency) identified the 200-year protection plan as their preferred plan, which was recommended in the feasibility report. The Reclamation Board and SAFCA indicated that they would be the non-Federal sponsors for construction of this plan.

STUDY AUTHORIZATION AND GUIDANCE

The basic authority for the Corps to study flood control needs in the American River basin is in Section 209 of the Flood Control Act of 1962 (Public Law 87-874, dated October 23, 1962), which authorizes studies for flood control in northern California. Authorization for the reconnaissance study and subsequent feasibility study was included in the Fiscal Year 1987 Appropriations Act (Public Law 99-91, dated October 30, 1986) as specified in House of Representatives Report 99-670 (dated July 15, 1986). Additional study authorization was included in committee language accompanying the Fiscal Year 1988 Continuing Appropriations Act (Public Law 100-202, dated December 22, 1987).

Subsequent to completion of the feasibility report, Congress provided further guidance relating to the American River study in Section 9159 of the Department of Defense Appropriations Act for FY 93. (See Appendix A, Pertinent Correspondence.) In addition, this act authorized for construction the Natomas features described in the feasibility report. In summary, Section 9159 directed the Secretary of the Army to reevaluate the flood control project described in the feasibility report and to address these items:

- Reanalyze the outlet design for the flood detention dam to reduce frequent flooding of the river canyon, minimize soil sloughing, and ensure the safety of the dam and downstream flood control system.

- Review the features of the flood detention dam to determine if the design would preclude its safe expansion for water, power, or other purposes, and to identify extra costs associated with expansion at a later time.

- Report on other features and operational procedures that should be implemented in a coordinated flood protection plan, and to specifically address:

  - Increasing objective flows in the lower American River above the design capacity of 115,000 cfs
  - Permanently reoperating Folsom Reservoir at different levels of increased flood storage
  - Lowering the spillway at Folsom Dam
  - Transferring flood control obligations from Folsom Reservoir to a new flood control facility at Auburn
  - Utilizing existing and increased flood space in upstream reservoirs
  - Establishing offstream storage on Deer Creek

- Consult with, and solicit the views of, the National Academy of Engineering on the contingency assumptions, hydrological methodologies used in the preparation of the American River project, and other engineering assumptions and methodologies influencing the scope and formulation of the American River flood control alternatives.

A March 23, 1993, letter from local Congressional Representatives to the Acting Assistant Secretary of the Army for Civil Works clarified the intent of the Representatives concerning Section 9159. (See appendix A.) The letter identified more specific flood protection measures and other data that were to be analyzed in the Corps' reevaluation. These included:

- The effects on soils, plants, and wildlife in the Auburn Canyon of the periodic inundations that would be caused by a dry dam.
- Changes to operational criteria at Folsom Dam to improve flood protection while minimizing water, power, fishery, and recreation losses.
- Enlargement of Folsom Dam's outlet capacity, including use of the existing Folsom diversion tunnel.
- Enlargement of Folsom Reservoir.

PERTINENT STUDIES AND REPORTS

Following are summaries of significant studies and reports initiated or completed since the 1991 feasibility report that affect the study area for the American River project. These include studies and reports by the Corps, U.S. Bureau of Reclamation (Reclamation), and SAFCA.

CORPS OF ENGINEERS

Folsom Dam and Reservoir Reoperation, California, Operation Plan and Environmental Impact Statement (March 1992)

The operation plan presents the results of studies to identify the effects and costs of providing increased flood protection to portions of the Sacramento metropolitan area by increasing the seasonal flood control space in Folsom Reservoir. The report was based on an interim reoperation (10 years) of the reservoir to increase the flood space to 590,000 acre-feet to provide protection from a 100-year storm as defined by FEMA (Federal Emergency Management Agency). The report was completed in June 1992 and forwarded to the Assistant Secretary of the Army for Civil Works.

In October 1993, Reclamation informed the Corps that operating Folsom Reservoir to provide additional flood storage is within Reclamation's operational flexibility. Reclamation assumed the role of lead agency for further studies on modifying the operation of the reservoir and initiated negotiations with SAFCA to provide compensation for costs associated

with any adverse impacts of reoperation. No further action has been taken by the Corps on its 1992 operation plan.

Folsom Flood Management Plan

Section 9159 of the FY 93 Defense Appropriations Act also directed the Secretaries of the Army and Interior to jointly develop and implement a flood management plan for the American River and Folsom Dam that ensures prompt, reliable, and full use of the flood control capability at Folsom Dam. Additional information on this plan is included in chapter III.

U.S. BUREAU OF RECLAMATION

Central Valley Project Improvement Act (Public Law 102-575, Title 34)

This legislation was signed into law on October 30, 1992. The act mandates changes in management of the CVP, particularly for the protection, restoration, and enhancement of fish and wildlife. Major areas of change addressed by the act include:

- Annual dedication of 800,000 acre-feet of water to fish and wildlife
- Tiered water pricing applicable to new and renewed contracts
- Water transfer provisions, including sale of water to users outside the CVP service area
- Special efforts to restore anadromous fish populations by 2002
- Restoration fund financed by water and power users for habitat restoration and improvement, and water and land acquisitions
- Moratorium on new water contracts until fish and wildlife goals are achieved
- Moratorium on contract renewals until completion of an EIS (environmental impact statement)
- Installation of a temperature control device at Shasta Dam
- Implementation of fish passage measures at Red Bluff Diversion Dam
- Firm water supplies for Central Valley wildlife refuges
- Development of a plan to increase CVP yield

Reclamation is currently preparing a programmatic EIS addressing the many changes mandated by the Central Valley Project Improvement Act. Completion of the EIS is scheduled for May 1996.

American River Water Resources Investigation (ARWRI)

The purposes of this study are to (1) identify unmet water-related resources needs within Reclamation's American River service area, (2) formulate alternative plans to meet those needs, and (3) select a preferred and implementable alternative. The American River service area includes most of the American River drainage basin plus parts of the lower

Sacramento River below its confluence with the American River and a portion of the Delta, primarily in San Joaquin County. Issues to be addressed include water supply, water quality, fisheries, recreation, and power production.

The study is in phase III, detailed analyses of a recommended plan. Phase IV will include public review of the report and environmental documentation. The study is expected to be completed in mid-1996.

Wild and Scenic Rivers Studies

As part of its ARWRI, Reclamation was required to evaluate portions of the north and middle forks of the American River to determine their eligibility for NWSRS (National Wild and Scenic Rivers System) status. The results of those efforts are presented in the report "Technical Team's Inventory and Recommendation for Wild and Scenic River Eligibility and Preliminary Classification," dated September 14, 1992.

An interagency team evaluated 23 miles of the middle fork (from Oxbow Dam to the confluence with the North Fork) and a total of 21 miles of two separate reaches of the north fork (from the Colfax-Iowa Hill Bridge to the upper end of Lake Clementine and from North Fork Dam to the intake of the Auburn Dam diversion tunnel). The team concluded that each segment is "eligible" for further study and that each is unique in several ways and contains at least one "outstandingly remarkable" value. This finding was concurred with by the Regional Director. The next phase of the investigation, to determine suitability of each segment for NWSRS status, is being conducted as part of Reclamation's ARWRI. The results of this phase will be included in the EIS prepared for the ARWRI. An EIS is scheduled to be completed in 1996.

SACRAMENTO AREA FLOOD CONTROL AGENCY

Draft Swainson's Hawk and Giant Garter Snake Habitat Conservation Plan (HCP)
(February 1992)

This draft report was prepared by EIP Associates for SAFCA in compliance with the California Endangered Species Act. The principal goal of the plan is to create a legal framework which assures that the local agencies controlling land use in the Natomas and Meadowview areas of Sacramento will exercise their authorities in such a manner as to avoid jeopardizing the continued existence of the Swainson's hawk and giant garter snake as a result of urban growth. Work was stopped on this plan after completion of a second draft HCP by landowners in Natomas.

Draft Natomas Basin Habitat Conservation Plan for Sacramento and Sutter Counties, California (March 1995)

This draft report was prepared by Thomas Reid Associates and Cribbs and Associates in coordination with local landowners and local governmental agencies, including SAFCA, to comply with the Federal and California Endangered Species Acts. The purposes of this habitat conservation plan are to (1) mitigate for the loss of existing habitat to anticipated urban development and (2) reduce the potential for losses of the giant garter snake from operation of the water supply and drainage system. The goal of the HCP is to acquire, control, preserve, restore, and enhance habitat values of the Natomas basin while allowing urban development to proceed according to local land use plans. A final report will be completed by late 1995.

Final Environmental Impact Report for the Revised Natomas Area Flood Control Improvement Project (June 1993)

This report discusses alternatives designed to provide to the Natomas area and portions of the lower Dry and Arcade Creek basins as much flood protection as possible independent of any improvements that may subsequently be implemented along the main stem of the American River. (This work modifies that portion of the plan recommended in the ARWI 1991 feasibility report that was authorized as part of the FY 93 Defense Appropriations Act.)

Under the SAFCA plan, the levee and related improvements to be constructed around and adjacent to the Natomas basin would provide residents and property owners protection from runoff from a 100-year storm. The project would be compatible with all of the main stem American River alternatives being considered in the Corps' current reevaluation for the American River Watershed Project. The Natomas project is described in chapter III.

Final Environmental Assessment and Report for Interim Reoperation of Folsom Dam and Reservoir (December 1994)

SAFCA and Reclamation have agreed to modify the authorized operation of Folsom Dam and Reservoir to provide portions of the American River flood plain with as much immediate flood protection as possible with the existing flood control system. Through the agreement between SAFCA and Reclamation, the flood control diagram governing reservoir storage space allocations and outflows during flood control operations has been revised to reduce the probability of flooding in Sacramento to 1 chance in 100. This agreement has a 5-year term and is intended to be in place until a long-term flood control project is implemented in the basin. This project operation is described in more detail in chapter III.

Lower American River Task Force

SAFCA, in cooperation with the Corps and DWR (California Department of Water Resources), has initiated a collaborative planning process involving interested local, State, and Federal agencies and environmental and community organizations to provide recommendations for potential elements of flood protection plans for the lower American River. Primary elements addressed include (1) bank protection, (2) levee improvements, (3) environmental restoration concepts, and (4) recreation improvements. This group, known as the Lower American River Task Force, will also participate in preparing a future floodway management plan for the lower American River that will address (1) jurisdictional authorities and responsibilities within the floodway, (2) guidelines for ongoing vegetation management, (3) a plan for increasing the personal safety of river corridor users and for limiting the liability of the agencies responsible for maintaining the floodway, and (4) procedures for dispute resolution.

CHAPTER II

SACRAMENTO AREA PROBLEMS AND NEEDS

FLOOD PROBLEMS

EXISTING FLOOD CONTROL SYSTEM

Sacramento was established in the 1840's at the confluence of the Sacramento and American Rivers. Flooding was fairly common in the early days of the community. Over the years, a complex system of levees, upstream dams and reservoirs, and related facilities were built to help reduce flooding. (See plate 2.) The most significant of these facilities include elements of the Central Valley Project, Sacramento River Flood Control Project, American River Flood Control Project, and several local projects and plans. These projects are described in the feasibility report and highlighted here.

Central Valley Project

Major existing or authorized facilities of the CVP in the study area are Folsom Dam and Reservoir, Nimbus Dam, and the multipurpose Auburn Dam project.

Folsom Dam and Reservoir. Folsom Dam is on the main stem of the American River about 29 miles upstream from the Sacramento River. It is a multipurpose project operated by Reclamation as part of the CVP. The dam regulates runoff from about 1,860 square miles of drainage area and has a total (full pool) capacity of about 975,000 acre-feet. It has a seasonally designated flood control storage space of 400,000 acre-feet. A recent agreement between Reclamation and SAFCA has—through October 1999—increased the flood control storage to a variable space ranging from 400,000 acre-feet to 670,000 acre-feet depending on the amount of creditable vacant space in several existing reservoirs upstream in the basin. The objective release from the dam is 115,000 cfs.

The spillway at Folsom Dam consists of eight individual bays, each with a separate gate to help control outflows during floods. Five of the spillway bays are used for normal operations and during routine flood situations, and three are for emergency conditions. In July 1995, gate 3 failed during normal operations, causing uncontrolled evacuation of about 40 percent of the reservoir storage. Reclamation has provided an emergency closure system to preserve as much water as possible and expects to have the gate repaired by summer of 1996.

If Folsom Dam were being designed and constructed today, the spillway would be sized to safely pass the currently estimated PMF (probable maximum flood). The PMF is the largest flood in the basin believed possible. It is so rare that a frequency is not applied to it. Studies indicate that the eight spillway bays can pass only about 70 to 75 percent of the PMF. Even if the spillway could pass the PMF, flood damages in Sacramento during the PMF would be catastrophic. Additional studies will be made after a flood protection project has been selected to determine what, if any, additional work would be required to pass the PMF through Folsom without damage to the dam.

Nimbus Dam. Nimbus Dam and its reservoir, Lake Natoma, are located about 6 miles downstream from Folsom Dam. (See plate 2.) Lake Natoma (8,760 acre-feet) acts as a power afterbay to Folsom and as a diversion dam for the Folsom South Canal. Because of its small capacity, Nimbus has essentially no regulatory effect on floodflows in the American River.

Multipurpose Auburn Dam Project. The Auburn Dam project was authorized as part of the Auburn-Folsom South Unit of the CVP in 1965. If constructed, this project would provide added flood protection for Sacramento, M&I (municipal and industrial) water supply, hydropower generation, and added regional recreation opportunities. The principal features of the project include a 2.3 million-acre-foot dam and reservoir, and a powerplant on the North Fork American River above Folsom Reservoir. Construction was started in 1967, but ceased in 1975 following an earthquake registering 5.7 on the Richter scale which occurred near Oroville, California (60 miles from the Auburn site). Subsequent analysis of a redesigned dam determined that a structure at the site would be seismically safe. However, construction has not been restarted, mainly because of (1) a change in Federal policy concerning non-Federal cost sharing of water development projects (non-Federal sponsor must pay 100 percent of the hydropower and M&I water supply costs) and (2) aggressive opposition by environmental interests.

Since construction of Auburn Dam began, about $240 million in Federal funds has been spent to (1) acquire lands and rights-of-way, (2) prepare designs and estimates, (3) conduct geotechnical explorations, (4) construct the cofferdam and diversion tunnel, (5) excavate and treat the foundations for the main dam and powerplant, and (6) complete access roads and the Foresthill Bridge. In addition, about $140 million in interest has accrued on these costs, bringing the total Federal investment to date to about $380 million. Annual O&M (operation and maintenance) costs average $1.5 million.

Sacramento River Flood Control Project

Features of the Sacramento River Flood Control Project associated with the American River basin were completed by the Corps by 1958 and are maintained by non-Federal interests. They are highlighted on plate 2 and include:

American River Levees. The American River portion of the project consists of 10.8 miles of levee improvements along the south bank of the river (mouth of the American

River upstream to Mayhew Drain at Mayhew Road) and about 5.8 miles of improvements along the north bank (mouth of the American River upstream to near Cal Expo). These levees are considered capable of safely containing flows up to 115,000 cfs.

Natomas East Main Drainage Canal. The west levee of the NEMDC extends from the American River upstream about 13.3 miles to high ground near Sankey Road; the east levee extends from the river upstream about 4 miles to Dry Creek. The design capacity of the canal ranges from 16,000 cfs from the American River to Arcade Creek to about 1,500 cfs upstream from Dry Creek. Levees along the canal are being modified by SAFCA as part of the local Natomas project. Construction is expected to be completed in 1996. This construction also includes a gated-pump structure across the NEMDC just upstream from Dry Creek, primarily to reduce backwater flooding farther north.

Arcade and Dry Creeks. Levees extend along both sides of Arcade Creek from the NEMDC to high ground about 2 miles upstream. The levees were designed for a flow of 3,300 cfs. A levee extends along the south side of Dry Creek from the NEMDC to high ground about 1.3 miles upstream and has a flow capacity of 15,000 cfs. These levees are also being modified as part of SAFCA's Natomas project. The SAFCA project also includes a levee along the north bank of the creek from Dry Creek upstream to Marysville Boulevard.

Pleasant Grove Creek Canal. The Pleasant Grove Creek Canal is contained on the west bank by a 4-mile-long levee that extends from Sankey Road to the NCC (Natomas Cross Canal). The design capacity of the Pleasant Grove Canal is (1) 800 cfs from Sankey Road to Curry Creek, (2) 2,300 cfs from Curry Creek to Pleasant Grove Creek, and (3) 6,000 cfs from Pleasant Grove Creek to the NCC. Portions of the levees along the canal are included in the SAFCA project.

Natomas Cross Canal. The south levee of the NCC extends about 4.4 miles between the Sacramento River and the Pleasant Grove Creek Canal. The levee was designed to have 3 feet of freeboard at a flow of 22,000 cfs. Portions of the levees along the canal are included in the SAFCA project, along with a small detention basin adjacent to the canal near Pleasant Grove Creek Canal.

Sacramento River. The levees along the Sacramento River were designed to carry (1) 107,000 cfs in the reach from Fremont Weir downstream to the American River and (2) 110,000 cfs downstream from the American River.

Yolo Bypass. Yolo Bypass comprises a complex series of levee and channel improvements extending from the terminus of Sutter Bypass at the Sacramento River on the north to near Rio Vista on south. The bypass receives flow from west-side tributaries, the Sacramento River, and sometimes from the American River. When the combined flow of the Sacramento and Feather Rivers and Sutter Bypass exceeds about 70,000 cfs, most of the excess spills over the 9,170-foot-long Fremont Weir into the Yolo Bypass. Also, when flows in the Sacramento River at the streamflow gage at "I" Street bridge reach 27.5 feet and are rising—about 94,000 cfs—gates at the Sacramento Weir are opened sequentially, allowing

excess water to flow through the Sacramento Bypass into the Yolo Bypass, until either all 48 gates are open or the river stage at the weir stabilizes at 27.5 feet (NGVD). The design capacity of the Yolo Bypass is (1) 343,000 cfs from the Fremont Weir to the mouth of Knights Landing Ridge Cut, (2) 362,000 cfs from Knights Landing Ridge Cut to Cache Creek, (3) 377,000 cfs from Cache Creek to the Sacramento Weir, (4) 480,000 cfs from the Sacramento Weir to Putah Creek, and (5) 500,000 cfs from Putah Creek to the junction of the Yolo Bypass with the Sacramento River at Rio Vista.

American River Flood Control Project

The American River Flood Control Project was constructed by the Corps in the 1950's and is operated and maintained by DWR. The project consists of a levee along the north bank of the river, extending from the terminus of the Sacramento River Flood Control Project levee near Cal Expo upstream about 8 miles to Carmichael Bluffs. The levee was designed for a sustained flow of 115,000 cfs.

Others

Non-Federal Levees. Local interests have constructed levees on the south bank of the American River upstream from the project levees. These levees are between Mayhew Drain and Sunrise Boulevard and together total about 2.7 miles. The estimated safe channel-carrying capacity of the levees is about 115,000 cfs.

Upstream Reservoirs. Numerous reservoirs are located upstream from Folsom Reservoir, and most are owned and operated by local utility companies or districts. The total storage capacity of these reservoirs is about 820,000 acre-feet, but because of their relative size and location in the basin only five of them have a measurable influence on floodflows downstream from Folsom Dam. The five reservoirs are listed in table II-1. Of the nearly 740,000 acre-feet of total capacity in these reservoirs, about 200,000 acre-feet are effective in controlling runoff during many storms and may be counted on (in addition to designated flood control space in Folsom Reservoir) to help reduce floodflows. The recent agreement between Reclamation and SAFCA to reoperate Folsom Dam and Reservoir credits the available space in these reservoirs.

City of Sacramento Floodgates. The City of Sacramento has an emergency plan that includes both permanent and portable floodgates. The gates are located at railroads, streets, and other designed low points in the levees. (See plate 2.)

Emergency Preparedness Plans

The Federal Government, State of California, and local cities and counties have a series of emergency response and preparedness planning actions in the case of a flood or threat of flooding. Corps involvement includes planning and advice in advance of a potential

TABLE II-1

Existing Reservoirs Influencing Flood Space in Folsom

Reservoir	Stream/American River Tributary [1]	Owner [2]	Elev. Top of Dam (ft)	Capacity (acre-feet)
L.L. Anderson (French Meadows)	M. F.	PCWA	5,271	136,400 [3]
Hell Hole	Rubicon R./M. F.	PCWA	4,650	207,600
Loon Lake	Gerle Cr./M. F.	SMUD	6,418	76,500 [3]
Union Valley	Silver Cr./S. F.	SMUD	4,883	271,000 [3]
Ice House	S. F. Silver Cr./S. F.	SMUD	5,454	45,960 [3]
Total				737,460

[1] M. F., Middle Fork American River; S. F., South Fork American River
[2] PCWA, Placer County Water Agency; SMUD, Sacramento Municipal Utility District
[3] Effective storage is reduced during winter months for dam safety.

flood event and emergency assistance that includes repairing levee breaks, placing riprap along levees, placing material on levees to prevent overtopping, constructing additional protection levees, and providing sandbags.

The State of California, through the State-Federal Flood Operations Center, monitors weather and river information and other data around the clock during the rainy season and provides early flood warnings to local, State, and Federal agencies. At the same time, the State OES (Office of Emergency Services) and county OES staffs monitor flood information and prepare to help people. The OES network includes fire departments, law enforcement agencies, and highway and road departments.

Sacramento and Yolo Counties as well as the City of Sacramento have multihazard emergency plans that include procedures to be followed during flooding.

FLOODFLOW CONDITIONS

Floodflows in the American River basin are rather frequent and of two general types—winter rainfloods (a rain-on-snow situation) and spring snowmelt floods. Historically, floodflows resulting from intense winter rainfall over the foothills and mountains have caused serious flooding. Outside the winter season, storms are less severe, cover smaller portions of the basin at a time, and are so widely separated in time that existing basin flood control facilities are easily capable of controlling the runoff.

Folsom Dam and Reservoir were designed and constructed in the late 1940's to mid-1950's to protect urban Sacramento from a flood that would result from the largest rainstorm of record within the region occurring directly over the drainage basin, at a time when ground and snow cover conditions are moderately conducive to high runoff. Since the largest rainstorm of record at that time was the storm of 1937, Folsom was designed to safely pass that event centered in the American River basin. The "maximized" 1937 flood was estimated to have a peak inflow of 340,000 cfs and a 6-day volume of 978,000 acre-feet. This was defined as the reservoir design flood, or RDF, and was believed not likely to occur any more often than once every 250 years.

The February 1986 storm of record in the basin demonstrated the difficulties inherent in the efforts to anticipate large storm events by extrapolation from a sparse record. After correcting for the effects of the collapse of the Auburn cofferdam, which occurred during the fourth day of the storm, it was determined that the storm had an unregulated 1-day inflow of 171,000 cfs. Even though the peak inflow to Folsom was significantly less than the 340,000 cfs for the RDF, the overall volume of the event was 16.5 percent greater than the RDF. During February 1986, releases from Folsom Dam exceeded 115,000 cfs for 2 days and reached 130,000 cfs for about 24 hours. These large floodflows eroded the riverbanks in some locations, undermining portions of the levee along the lower American River, and came within a foot of overtopping the west bank of the Natomas East Main Drainage Canal and flooding portions of Natomas.

Hydrologic studies since 1986 show that Folsom Dam and Reservoir and the flood control levees do not provide as much protection as previously thought. The 1986 storm had a return period estimated to be about 67 years. This was significantly less than the storm that in the 1950's was believed to be able to be controlled by the dam and levee system. Without the "incidental" storage space that was available in several of the water and power reservoirs in the upper American River basin, the 1986 flood would have overwhelmed the flood control system.

Folsom Operation

The ability of Folsom to maintain the objective release of 115,000 cfs is based on the amount of reservoir storage space available for flood control and the efficiency with which the dam can be operated to achieve design releases during a storm. Under the existing authorized operating criteria, 400,000 acre-feet of the total storage of 975,000 acre-feet at Folsom is allocated to flood control during the flood season. However, Reclamation and SAFCA are currently operating to a variable space ranging from 400,000 to 670,000 acre-feet.

Releases from the dam can be made through eight gated outlets (two tiers of four gates each) at the lower level of the dam, three power penstocks, five main-spillway gates, and three auxiliary-spillway gates. Only the main-spillway gates are used in regular operation. The auxiliary-spillway gates are used only in emergencies. Releases are limited

by the capacity of these discharge structures and by existing operation criteria, which limit the rate at which releases may be increased.

Currently, when the vacant space in the upstream reservoirs is at least 200,000 acre-feet, the flood space requirement in Folsom Reservoir is 400,000 acre-feet. The reservoir is then holding a maximum of 575,000 acre-feet of water, and the maximum discharge capacity is about 36,000 cfs. If the space in the upstream reservoirs is less than 200,000 acre-feet, the required vacant space in Folsom is increased in accordance with the flood control diagram shown in plate 3.

As floodwater enters Folsom Reservoir and inflow exceeds the maximum outlet capacity, the reservoir starts to fill. The outlet capacity remains at 36,000 cfs until the water level reaches the spillway crest, at which time releases can be increased up to the 115,000-cfs objective release. Depending on the magnitude of the inflow, the discharge may then be maintained at 115,000 cfs by regulating the main-spillway gates. Should the inflow to Folsom Reservoir increase beyond the rate at which the reservoir can be evacuated, the reservoir begins to fill more—encroaching further into the designated flood control storage space. Some increased filling (using surcharge storage space) is acceptable. However, beyond a certain elevation, additional flows need to be released from the dam that exceed the safe carrying capacity of the downstream river channel. When this occurs, the downstream levee system is in danger.

American River Flow Frequency

Flow, or discharge, frequency is a measure of the expected peak, or maximum, riverflow for various frequency events. Plate 4 shows a discharge-frequency relationship for three conditions for the America River near Fair Oaks. These three are (1) unregulated conditions, (2) baseline conditions, and (3) without-project conditions or no action. Unregulated conditions are an estimate of flows for various frequency storms assuming Folsom Dam and Reservoir did not exist; it is representative of the peak inflow to Folsom Reservoir. Baseline conditions are conditions before reoperation of Folsom Reservoir under the current agreement between Reclamation and SAFCA. Without-project conditions are expected peak flows assuming reoperation of Folsom Reservoir. For illustration, table II-2 shows estimated peak flows from Folsom in the American River for various frequency floods.

Downstream American River

Because of the complex interrelationships between flows in the American River, Sacramento River, and contributing river bypasses, creeks, and streams, as well as topographical conditions, potential flooding downstream is characterized by river stages. River stages and profiles of various flows are included in Appendix A (Hydrology) of the 1991 feasibility report.

TABLE II-2

Discharge Frequency - American River at Fair Oaks Streamflow Gage

Return Period (Yrs)	50	100	200	400
Peak Inflow - Unregulated Conditions (cfs)	272,000	353,000	450,000	560,000
Peak-Flow - Baseline Conditions (cfs)	115,000	220,000	450,000	560,000
Peak Flow - Without-Project Conditions (cfs)	115,000	150,000	450,000	560,000

LEVEE FAILURES AND LOCATIONS

The potential of flooding in Sacramento is magnified by the area's dependence on high earthen levees. High levees essentially function as long dams, but without normal dam safety features such as auxiliary spillways, outlet facilities, and structural features to withstand earthquakes. Floodwater moving at erosive velocities for miles along the waterside slope of the levees need only encounter a single weak spot in the system to cause a breach and, potentially, uncontrolled, life-threatening flooding.

Levees can fail for several reasons, and it is difficult to predict how and where they will fail. Levees have failed when the stage, or height of the water surface, was significantly below the design flow. In other cases, floodflows have encroached into the design freeboard (or safety level), but without levee breaching or significant damages.

For current studies, the locations and likelihoods of initial levee failure are based on an analysis of weak points in the levee system as determined by a geotechnical assessment of levee stability. To define these weak points, "probable nonfailure points" (PNP) and "probable failure points" (PFP) were defined along the levees. The PNP is the highest water-surface elevation at which levee failure is highly unlikely. Conversely, the PFP is the water-surface elevation at which levee failure is highly likely.

For this study, the PNP is the point at which the chance of failure is 15 percent; for the PFP, the chance of failure is 85 percent. Plate 5 is a profile of the left- and right-bank levees along the lower American River. The PNP and PFP were based on the results of field inspections, levee stability calculations, and levee performance in February 1986. On the basis of this information, levees are expected to be relatively safe from failure with occasional short-term flows of about 130,000 cfs—and highly likely to fail with flows of about 160,000 cfs.

FLOOD PLAINS

To help in assessing potential flood damages, the areas of Sacramento that would be subject to major flooding from levee failure were identified. These areas of likely flooding, or flood plains, were developed on the basis of computed river stages, levee stability conditions during high flows, and topography. Plate 6 shows the likely area of inundation for a major flood. The flood plain was divided into six subareas: (1) Natomas, 54,900 acres; (2) Dry Creek, 5,800 acres; (3) North Sacramento, 5,900 acres; (4) Rancho Cordova, 4,200 acres; (5) South Sacramento, 44,000 acres; and (6) Richards Boulevard, 1,000 acres.

Once levees fail, the resultant flooding would be severe in Natomas, parts of downtown Sacramento, and, to some extent, north Sacramento areas—regardless of the frequency of the flood. This is because (1) the ground elevation adjacent to the levees in these locations is lower than the water surface in the river and (2) the volume of water in the American River (and Sacramento River in the case of Natomas and downtown Sacramento) would cause deep flooding. Shallower flooding would affect the Dry Creek, South Sacramento, and Rancho Cordova reaches, but progressively more area would be flooded as increased flows were diverted through the levee break.

The likelihood of flooding in the Natomas and Dry Creek areas is being greatly reduced by current levee and related construction by SAFCA. Any levee failure on the Natomas Cross Canal would permit Sacramento River flows to enter the Natomas area via the canal. In addition, runoff entering the NCC from the east would be conveyed through the breach. The volume of water passing through the breach would depend on several factors, including (1) the size of the breach, (2) flood stage and duration of floodflows in the Sacramento River, and (3) direct runoff into the Pleasant Grove area. If flood stages in the Sacramento River remained high for several days after a breach, then the entire Natomas area would likely be inundated to significant depths. The levees encircling Natomas are from 15 to 20 feet higher than the interior land surface.

FREQUENCY OF FLOODING

The frequency of levee failure and resultant flooding in Sacramento depends on the frequency of high flows in the American and Sacramento Rivers and on the condition of the levee system. For studies conducted for the 1991 feasibility report, the level of flood protection for the flood control alternatives was defined as the "exceedence interval" (in years) of a storm whose runoff could be controlled by the flood control system to the objective release. The exceedence interval was determined from the discharge-frequency curves and is the point at which flood releases would exceed the objective release (on plate 4, the end of the flat part of the curve at the objective release). From plate 4, it is estimated that the flood control system could control outflows from Folsom Reservoir to the objective release of 115,000 cfs for up to a 67-year flood for baseline conditions and for up to an 85-year flood for without-project conditions. Therefore, they were said to have a 67-year and 85-year level of protection, respectively. The "baseline condition" represents an

operation of Folsom Dam and Reservoir existing prior to the recent agreement between Reclamation and SAFCA for interim increased seasonal flood space. The "without-project conditions" assumes the agreement continues indefinitely.

For evaluating flood protection alternatives in this report, the likelihood of flooding, as determined by levee failures, was computed using risk-based computer simulations termed "risk and uncertainty analysis," or "R&U." (See Appendix B.) The simulations consider varying degrees of uncertainty in the causes of flooding, such as inflow to Folsom Reservoir, regulated outflow-frequency relationships for Folsom Dam, river stages, and levee stability. The computer program simulates a large number of floods and statistically determines the probability of levee failure or estimated exceedence by dividing the number of simulated levee failures by the total number of flood simulations. The level of flood protection is characterized as probability of flooding due to levee failure in any given year. This probability is expressed as the chance of flooding out of a given number of storms detemined by taking the reciprocal of the estimated exceedence. Thus, a levee with a 0.01 estimated exceedence is said to have 1 chance in 100 of flooding due to levee failure.

Based on R&U, flooding in Sacramento would occur due to levee failure with a probability of 1 chance in 80 under baseline conditions and 1 chance in 100 for without-project conditions (reoperation of Folsom). This is a statistical estimate based on computer simulations of the levees under thousands of flood conditions. This does not mean that there is no risk from a specific storm that has a return frequency less (more frequent) than the flood control system's estimated exceedence. For example, table II-3 shows for without-project conditions the likelihood of levee failure on the American River for four representative floods. This is another measure of flood risk, the chance of failure during a particular flood. For example, the chance of levee failure during a 100-year flood is estimated to be 41 percent. The likelihood that a levee will not fail, or its reliability, is 59 percent.

The table also shows the calculated estimated exceedence. This is an estimate of the overall chance that the flood control levees will not fail. For example, under without-project conditions, there is approximately 1 chance in 100 that the levees will fail in any given year.

Plate 7 shows still another way to characterize flood risk. It shows the risk (in percent) that particular floods (and levels of flood protection) will be exceeded over specific time periods. For example, the chance that the levees would fail under without project conditions during any 50-year period is 39 percent. For baseline conditions, the chance is 47 percent.

However, knowing these percentages does not give a true sense for the risk. Some risks cannot be controlled, while others, such as the risk of flooding, can be altered by flood protection projects. Flood risk can be compared to the risk of other calamities, as shown in table II-4. For example, the likelihood of flooding in Sacramento is significantly greater than the likelihood of personal injury in an automobile accident or house damage or loss by fire.

TABLE II-3

Likelihood of Levee Failure and Major Flooding Without-Project Conditions (.01 estimated exceedence)

Storm		Percent Chance of Levee Failure	Reliability of Levee System (percent)
Return Period (years)	Exceedence Frequency per 100 Years (percent)		
50	2.0	7	93
100	1.0	41	59
200	0.5	83	17
400	0.25	98	2

TABLE II-4

Comparative Risks of Flooding and Other Calamities

Loss	Percent Chance of Occurrence	
	1 Year	50 Years
House damage by fire [1]	0.35	16
Automobile accident with injury [2]	0.72	30
Flooding in Sacramento		
Baseline conditions	1.28	47
Without-project conditions (Folsom reoperation)	1.00	39

Source:
[1] California Fire Incident Report, 1994.
[2] Statistical Abstract of United States, Bureau of the Census, 1993.

FLOOD DAMAGES

Major flooding in an urban environment has many adverse consequences, including monetary damages and loss of real property. Monetary loss is the primary way of depicting flood damages and assessing the effectiveness of flood protection alternatives. However, floods have many other disturbing, nonmonetary effects. Among these are effects on public health and safety, damages from toxic and hazardous waste contamination, and loss of environmental resources in the flood plain. Following are brief descriptions of potential monetary and nonmonetary consequences of flooding in Sacramento.

Property, Business, and Government

Damageable property in Sacramento's flood plain consists of commercial, industrial, residential, and public buildings valued at nearly $37 billion. (See Appendix C, Economics.) Direct structure-inundation damages from levee failure during a 400-year storm would be about $16 billion. Additional effects on the day-to-day business of the Sacramento area would also be significant. Many businesses would be forced to close, at least temporarily, during flooding and cleanup afterward, resulting in lost revenues and wages.

Average annual damages are the expected value of damages for a given economic condition and point in time. They are determined by weighing the estimated damages from varying degrees of flooding by their probability of occurrence. Average annual equivalent flood damages (excluding future development) would be about $142 million.

In addition to the physical damage suffered in the Sacramento area, transportation disruption could adversely affect businesses regionally and Statewide. A major flood would result in significant disruption and potential damage to Interstate Highways 5 and 80, which are major north-south and east-west transportation corridors in California. State Highways 99, 160, and 50 would also be affected, as would Sacramento's light rail system, Amtrak passenger service, and the Union Pacific and Southern Pacific commercial rail lines.

Sacramento is also the capital and center of government of the State of California. A major flood would significantly affect the State government's ability to function on a day-to-day basis, which would have far-reaching impacts outside the area damaged by the flood.

Public Health and Safety

Nearly 400,000 people reside within the flood plain of the American River. The effect of levee failure and resultant flooding on human life would depend on the flood magnitude, population at risk, flood-warning time, depth of flooding, time of day, and availability of evacuation routes. It would not be unreasonable to expect as many as 25 drownings during a very large flood. The estimated number of fatalities would significantly increase depending on the time of day, warning time, and suddenness of the levee breach. In addition to loss of life, major flooding could result in life-threatening injury

and spread of some waterborne infectious diseases. Just evacuating the flood plain could result in traffic accidents and injuries associated with the rapid displacement of nearly 400,000 people.

Toxic and Hazardous Waste Contamination

Flooding would result in significant releases of toxic and hazardous substances from above-ground tanks and drums containing heating oil, fuel oil, liquid propane, and kerosene; agricultural chemicals such as herbicides, pesticides, solvents, and fertilizers; many commercial and industrial chemicals; and untreated wastewater. Widespread flooding could also result in ground-water contamination.

Other Impacts

Major flooding would likely result in large quantities of flood-related debris, most of which would have to be collected and hauled to local landfills. Also, rebuilding or relocating homes, businesses, and related infrastructure would require additional natural resources.

Flooding would have impacts on urban landscaping and wildlife. In addition, some special-status wildlife and plant species could be affected by inundation. Depending upon their tolerance to inundation, some species could even be eradicated from the Sacramento area as a result of a very large flood. These species include the giant garter snake and the valley elderberry longhorn beetle as well as a variety of plants, including diffuse rush, delta tule pea, Sanford's saggitaria, bird's beak, Downingia, hege-hyssop, California hibiscus, toad rush, and valley oak.

RELATED WATER RESOURCES PROBLEMS AND NEEDS

In directing the Corps to do the American River feasibility study, Congress said to (1) assess how the operation of Folsom Dam and any new peak-flow flood control facility identified might relate to incidental water, power, and recreation benefits; and (2) analyze current and projected water supply demands in the American River basin. During the study, it became evident that there also is significant concern and interest in the potential to restore environmental resources along the lower American River. Information on local water and power demands is included in the feasibility report and summarized below. Opportunities for recreation development and environmental restoration are also summarized.

WATER SUPPLY

Water supply and conveyance are concerns in Placer, El Dorado, Sacramento, and San Joaquin Counties. In summary, (1) Placer County has sufficient water entitlements to meet future demands but will need distribution facilities, (2) El Dorado, Sacramento, and San

Joaquin Counties will require additional supplies to meet future demands, and (3) El Dorado, Sacramento, and San Joaquin Counties will require some additional facilities to convey this water to growing service areas. The Bureau of Reclamation is assessing in detail these water supply needs and potential solutions as part of its American River Water Resources Investigation.

POWER

Demands in California for power are expected to grow at an annual rate of between 1.5 and 2.5 percent in the foreseeable future. The rate is expected to be greater in the northern portion of the state, including the SMUD service area. Northern California currently has adequate capacity from its basic system plus nondeferrable sources to meet requirements through 1997. After 1997, planned power developments are projected to supply remaining needs through 1999. Needs for electric power in the Sacramento area are expected to exceed locally available supplies after the year 2000, indicating higher prices in the future.

RECREATION

The upper American River canyon, Folsom Lake, and lower American River provide prime and unique resources for outdoor recreation. Future recreation demands will increase substantially in all these areas because of the large population base surrounding them and expected growth.

The lower American River is officially designated a "recreational river" within both the State and National Wild and Scenic Rivers Systems. Paralleling the lower river in Sacramento is the American River Parkway, a 5,000-acre greenbelt used by about 5.5 million visitors each year. Sacramento County estimates that use of the parkway will increase to 7.5 million visitors by the year 2000 and to 9.6 million by the year 2020. Demand will continue to be high for the types of activities suitable within the parkway, including walking, hiking, boating, cycling, beach use, nature study, picnicking, and camping. However, because of the rapidly expanding population of the area, open-space areas are needed to preserve important natural values of the landscape. The popularity of the American River Parkway and its trail system is evident by the highly intensive use, which sometimes exceeds the safe capacity. Additional paved bicycle trails and equestrian trails, especially along "natural" appearing areas, are needed.

ENVIRONMENTAL RESTORATION

Flows in the lower American River are greatly influenced by Folsom Dam and other water resources developments in the basin. These facilities, along with other river-related features such as bridges, levees, diversions, and the parkway system along the lower river,

have tended to change the geomorphic, riparian, and related riverine character of the river from its historical character. These changes, including lateral bank erosion, will likely continue and thus reduce riparian, wildlife, and related habitat values along the lower river. The need is critical to preserve the resources remaining and, as much as possible, restore lost resource values.

CHAPTER III

PROJECT SETTING AND WITHOUT-PROJECT CONDITION (NO ACTION)

This chapter reviews baseline conditions in the study area and changes to the "without-project condition" described in the 1991 feasibility report. The without-project condition is a description of the expected physical, environmental, and social conditions that would occur in the study area if no flood control project is constructed and is the condition against which flood protection plans are formulated and evaluated.

BASELINE CONDITIONS

Following is a summary of existing conditions in the study area. Detailed descriptions of existing conditions and expected future changes in these conditions are contained in the DSEIS/SDEIR.

PHYSICAL SETTING

The American River basin drains about 2,100 square miles of the western slope of the Sierra Nevada range in northern California and, in the Sacramento area, forms a flood plain covering roughly 110,000 acres at the confluence of the Sacramento and American Rivers. The flood plain includes most of the developed portions of the city of Sacramento and the Natomas basin.

Folsom Dam and Reservoir are located about 29 miles east of downtown Sacramento at the base of the foothills in the lower portion of the American River basin. The basin above the dam is rugged, with rocky slopes, V-shaped canyons, and few flat valley or plateau areas. Elevations range from 10,400 feet at the headwaters to about 200 feet at Folsom Dam, and the average basin slope is approximately 80 feet per mile. Below the dam, the land slopes gently to Sacramento at the trough of the Sacramento Valley. The elevation in downtown Sacramento is about 20 feet.

The major portion of the seasonal runoff from the American River basin is from December through February. The seasons are so distinctly different that May to October is termed the dry season and November to April the wet season. Precipitation varies throughout the drainage area, ranging from 16 to 20 inches on the valley floor to about 70 inches in the higher mountains. Average precipitation over the basin above Folsom Dam is about 53 inches. Precipitation usually falls as rain up to the 5,000-foot elevation and as

snow at higher elevations, but some storms produce rain up to the highest elevations of the basin. Winter snowfall above 5,000 feet normally accumulates until April, when increasing temperatures mark the beginning of snowmelt season. Average runoff from the basin is 2.8 million acre-feet. Streamflow varies throughout the year and is highest in winter and spring and lowest in late summer and fall.

CHANGES TO FLOOD CONTROL SYSTEM

Major changes to the American River flood control system since the 1991 feasibility report are (1) construction of SAFCA's local Natomas project and (2) interim reoperation of Folsom Dam for additional flood protection.

SAFCA Local Project

The FY 93 Department of Defense Appropriations Act (FY 93 DoD Act) authorized construction of the Natomas features of the American River watershed project as described in the 1991 feasibility report. The features include levee improvements at several locations along the NEMDC, Pleasant Grove Creek Canal, Natomas Cross Canal (NCC), and lower Dry and Arcade Creeks; channel modifications in the NEMDC; construction of a gated pumping station above Dry Creek; and a 3,000-acre-foot detention basin in the northeast corner of Natomas.

Because of the need for immediate action to reduce flood risks in the project area, SAFCA is proceeding with a stand-alone project to provide as much flood protection as possible to the Natomas area without the upstream improvements recommended in the feasibility report. As a result, SAFCA is raising the levee along the NCC, NEMDC, and north levee of the American River about 1 foot higher than specified in the feasibility report. The Natomas project is scheduled to be completed by late 1996. Basic features of the project are shown on plate 8.

Natomas is completely ringed by levees, and each major section of levee has a different "reliability," or susceptibility to failure. Before construction started on the project, the NCC and the NEMDC near the American River were the weakest sections in the system—the NCC was susceptible to failure with a probability of 1 chance in 50, and the NEMDC about 1 in 78. Completion of the project will increase the level of protection to Natomas to less than 1 chance in 500 of failure for all levee reaches except the east levee of the Sacramento River between the NCC and I-5 and the NCC. The Sacramento River reach would still be susceptible to flooding from levee failure with a probability of about 1 chance in 140, while the NCC would have a probability of failure of 1 chance in 400.

The flood protection improvements for Natomas change the hydraulic regime of the area, primarily for smaller, more frequent floods. Before the project, Natomas would have been one of the first areas in Sacramento to flood. Natomas would serve as a reservoir, storing floodwater that otherwise would pass through the flood control system. With the

Natomas improvements, this water now will flow past the mouth of the American River to the Sacramento River and the Sacramento Weir. This increased flow will have a very minor impact on the reliability of levees along the lower Sacramento River, but a significant effect on the reliability of levees in the West Sacramento area, particularly for the more frequent events, as the higher flows pass more frequently through the Sacramento Weir. Once in the Yolo Bypass, the increased flow volume will have a moderate effect on the reliability of the levees there.

SAFCA's Natomas project does not include measures to offset these hydraulic impacts to West Sacramento. However, the current reoperation of Folsom Dam and Reservoir will significantly improve reliability of the West Sacramento area levees (as well as other reaches in the study area), so it is considered in part as mitigation for the hydraulic impacts. If a permanent flood protection plan for Sacramento is not undertaken, then SAFCA would have to mitigate for the hydraulic impacts on West Sacramento. Continuation of the interim reoperation on a permanent basis would be one way to do that.

Interim Reoperation of Folsom Dam for Flood Control

The current reoperation of Folsom Dam and Reservoir as negotiated between SAFCA and the Bureau of Reclamation changes the maximum seasonal flood space requirement in Folsom from the fixed 400,000 acre-feet to a variable maximum of 400,000 to 670,000 acre-feet, based on the storage space available in the five reservoirs upstream from Folsom. (See plates 1 and 3). Under the variable operation, a daily accounting of the empty space in these reservoirs is made from October 1 to June 1 each year, and then the Folsom requirement is set accordingly.

Maximum flood storage is required from approximately December 1 through March 1. During this time, the flood storage reservation (empty space) in Folsom is 400,000 acre-feet, as long as the empty space in the upstream reservoirs is 200,000 acre-feet or more. Any reduction in the upstream space requires an incremental increase in Folsom's flood storage reservation. If all the space in the upstream reservoirs is filled, Folsom's reservation is increased to 670,000 acre-feet. Thus, beginning December 1 each year, the water-storage level in Folsom Reservoir is drawn down to 575,000 acre-feet or as little as 305,000 acre-feet, depending on the space in the upstream reservoirs.

The variable reservoir operation increases Sacramento's flood protection level. The risk of levee failure along the lower American River in any one year is reduced from 1 chance in 80 to 1 chance in 100. Reoperation of Folsom Dam and Reservoir will also improve the overall reliability of levees throughout the flood protection system.

SOCIOECONOMIC CONDITIONS

The American River's 400-year flood plain covers about 110,000 acres and includes 162,000 housing units occupied by more than 400,000 people. The primary land uses are

residential, commercial, industrial, and public. About 25 percent of the Natomas area is developed with the remainder in agriculture or vacant. The economy of the Sacramento area is based primarily on government, services, retail trade, and agriculture.

The major transportation facilities in the study area are Interstate 80, Interstate 5, U.S. Highway 50, State Route 99, Business 80, and State Highway 49. These regional facilities connect residential locations with employment, commercial, and recreational activity centered in the area and located around the central city (Sacramento) area. Traffic congestion typically occurs weekdays from 7 to 9 a.m. and from 4 to 6 p.m. The lower American River area is generally "built out" and has extensive transportation facilities. Traffic becomes congested during peak commute times, especially along the Howe and Watt Avenue corridors near Highway 50 and Interstate 80. Both Howe and Watt Avenues cross the lower American River.

Both Placer and El Dorado Counties, in the central portion of the basin, are experiencing rapid population growth. Much of the American River canyon area upstream from the Auburn Dam site is Federally owned. About 17,000 acres were acquired by Reclamation in the 1970's for construction of a multipurpose Auburn Dam. Much of this land and 25,000 acres more for the project are managed by the California Department of Parks and Recreation as part of the Auburn State Recreation Area. The main use of this area is recreation.

Placer County's economy is based on retail trade, service industries, government, and construction. In El Dorado County, tourism provides the economic base. Retail trade and service industries are expected to continue to grow. Major transportation routes in the Auburn area are Interstate 80 from Sacramento to Reno and Highway 49 to Placerville and to Grass Valley and Nevada City. Current regional transportation planning includes evaluations of new facilities to remove through-traffic from the local transportation facilities, and improvements to existing facilities, including expanded transit systems, additional roadway capacity, and high-occupancy vehicle lanes.

ENVIRONMENTAL RESOURCES

The western part of the study area in and around Sacramento contains a diverse array of vegetation and fish and wildlife habitats in the agricultural and open-space areas. Extensive riparian corridors along the American and Sacramento Rivers provide relatively rare, high-value habitat. Native vegetation includes open-water aquatic, emergent wetlands, riparian scrub, oak woodlands, hardwood, and grasslands. Vegetation in the flood plains is primarily agricultural crops with limited riparian and wetland areas.

The study area contains habitat used by a wide variety of game and nongame wildlife species, including deer, mountain lion, grey fox, and many species of small mammals, reptiles, and songbirds. Wildlife populations associated with riparian areas include Swainson's hawk, great blue heron, mallard, killdeer, and red-tailed hawk. More than

40 species of fish inhabit the lower American River, including a number of anadromous species. The study area is also inhabited by 13 Federally listed threatened or endangered species and 3 State-listed species.

Water quality in the American and Sacramento Rivers is generally good as a water source for municipal, industrial, and agricultural supply. However, standards for heavy metals, temperature, dissolved oxygen, and pH (hydrogen-ion concentration) are occasionally exceeded. The likely sources of nutrient and heavy-metal loadings are stormwater runoff, agricultural runoff, and other urban and agricultural land use practices. The operation of the complex system of reservoirs, debris dams, and diversion structures in the upper part of the basin normally increases summer and fall streamflows in the main stem of the American River.

The Sacramento region has been designated by the U.S. Environmental Protection Agency (EPA) as a "nonattainment" area for air quality, meaning the area exceeds Federal standards for ozone, carbon monoxide, and suspended particulate matter. Ozone is the main component of photochemical smog. The primary sources of suspended particulate matter in the area are onroad vehicles (cars, trucks, etc.), aircraft, trains, construction equipment, boats, and offroad vehicles. These sources, termed "mobile," produce about 63 percent of the area's hydrocarbons, 72 percent of the nitrogen oxides, and 97 percent of the carbon monoxide.

All of Placer County (except the Lake Tahoe Air Basin) has been designated a nonattainment area for ozone and suspended particulate matter. Due to the direction of prevailing air currents, the Auburn area—the major urban center in the county and in the upper American River basin—is subject to air contaminants originating in Sacramento and from agricultural burning in the valley.

A total of 42 archeological sites, 7 historic properties (determined eligible for the National Register of Historic Places), and 3 potentially historic (potentially eligible) railroad bridges have been identified in the lower American River area. At least 123 prehistoric sites and approximately 52 historic-era properties have been recorded at Folsom Reservoir. There are currently 35 documented potential historic sites located within 1 mile of the Sacramento River in Natomas. These areas have not been systematically surveyed, and additional sites likely exists. The potential for discovery of additional cultural resources is high in the Auburn area. Approximately 1,600 historic and 125 prehistoric sites have been identified in the upper American River basin.

There are 1,430 known hazardous or toxic waste sites in the lower American River project area. There may be agricultural chemical residue or deposits along the Yolo Bypass levees, and one former landfill site is adjacent to the north levee of the Sacramento Bypass. Two hazardous waste sites have been identified near the upper American River canyon area.

WITHOUT-PROJECT FUTURE CONDITIONS (NO ACTION)

The purpose of the "without-project conditions" section of this chapter is to describe the changes expected in the study area over the 100-year period of analysis used for this study, assuming a long-term flood protection project is not built. This without-project condition serves as the base against which alternative flood protection plans will be evaluated to determine their effectiveness and to identify impacts that would result for them.

PERTINENT FLOOD CONTROL FACILITIES

The six actions described below have been authorized and are expected to be completed by the time an American River Watershed project is implemented. Therefore, the current studies assume that for the period of analysis for impacts and benefit determination that these action are in place.

West Sacramento Project

The Water Resources Development Act of 1992 (WRDA 92) authorized construction of levee improvements in the West Sacramento area. Approximately 5.7 miles of levees along the south side of the Sacramento Bypass and the east side of the Yolo Bypass from the Sacramento Bypass to the Sacramento Deep Water Ship Canal will be raised a maximum of 4.9 feet and protected with stone revetment. A floodgate will be constructed across the Southern Pacific Railroad on the east levee of the Yolo Bypass to control the higher waters. The project will provide a high level of protection to West Sacramento. The West Sacramento project is scheduled to be completed in fall 1997.

Folsom Dam Spillway Gate Repairs

Repairs to spillway gate 3 at Folsom are scheduled to be completed by fall 1996. In addition, the remaining gates have been rehabilitated to ensure their proper operation. Once all work is completed, the full capacity at the spillway will be restored.

Folsom Flood Management Plan

The FY 93 DoD Act directed the Secretaries of the Army and Interior to jointly develop and implement a Flood Management Plan for the American River and Folsom Dam. Reclamation and the Corps have cooperated in preparing the plan, whose objectives are to maximize the flood control capability within the 400,000-acre-foot flood reservation of Folsom Dam and to improve the streamgage network and flood forecast system for the upper American River basin. In addition, the plan recognizes that reservoir releases need to be made as quickly as possible in anticipation of incoming flow and in accordance with the existing water control manual.

The plan recommends features and operational changes to (1) increase the allowable rate of increase in Folsom Dam outflow from 15,000 cfs in a 2-hour period to 30,000 cfs in a 2-hour period, (2) implement a 4-hour response time in which to begin actions to match reservoir outflows to inflows, (3) improve the existing downstream flood-warning system, (4) install telemetered streamflow gages, (5) automate flood control gates at Folsom and Nimbus Dams, and (6) modify the river outlets at Folsom Dam to allow their full use in combination with spillway releases.

The Corps will revise the water control manual for Folsom to reflect the 4-hour response time and the new rate of increase for flood control releases, as part of its O&M program. Reclamation has agreed to implement those items that are applicable to its day-to-day operations, under its O&M program. This work includes automation of the five main-spillway gates and eight river outlets at Folsom Dam and the first six spillway gates at Nimbus Dam. (The operation of the automated gates will be tested for several years, after which they will be reanalyzed to determine if the remaining 12 spillway gates at Nimbus Dam should be automated.) Reclamation will also install components of the flood-warning system at Folsom (radio base station, auto-dialer, and remote siren/PA at the Rainbow Bridge) and Nimbus Dams (remote siren/PA system at Hazel Avenue bridge). These features of the Flood Management Plan will be budgeted for final design and a construction start in accordance with Reclamation's budget policies (expected completion in 1999).

The remaining items—the Sunrise Boulevard bridge remote siren/PA portion of the flood-warning system; telemetered stream gages on the north, middle, and south forks of the American River; and modification of Folsom River outlets—are addressed in this report as part of an American River Watershed project.

Folsom Dam Safety

The probable maximum flood (PMF) is the most severe flood capable within a watershed. It is an extremely rare event. Folsom Reservoir can only pass about 75 percent of the PMF before the main dam and/or one or more of the wing dams or dikes are overtopped. Once overtopping occurs, catastrophic flooding would occur downstream from Folsom or to the cities of Folsom or Roseville depending upon where overtopping occurs. It is expected that for the foreseeable future, under the No-Action Alternative, this condition would remain unchanged. The primary reason is that during a PMF event, flood releases are so great that even if Folsom could safely pass the event (without overtopping), downstream flooding would be similar to conditions had Folsom Dam not been upgraded.

Sacramento River Bank Protection Project

Vertical erosion of the bed of the lower American River is not a significant problem because erosion-resistant outcroppings in the bed prevent down cutting of the channel. The primary concern is lateral erosion along the erosion-resistant sediments and outcroppings that cause failure of the riverbanks and, if unchecked, can threaten project levees.

Bank erosion is a continuing process in the lower American River. Under current O&M requirements, the non-Federal sponsors (Reclamation Board, American River Flood Control District, and Reclamation District 1000) are required to perform maintenance to protect the levee from failure due to bank erosion. For a number of reasons (including financial constraints, disagreement about jurisdiction, and opposition from resources agencies to recommended types of protection), this maintenance work often is deferred until an emergency arises.

The condition of the existing banks and levees has been analyzed to identify potential levee sites that would be threatened within the next 11 years (the time to implement a long-term flood protection plan for Sacramento). SAFCA, through the Lower American River Task Force, a wide cross section of agencies and groups interested in bank protection issues, is working with the Corps to identify sites requiring protection and to develop environmentally sensitive fixes so that bank erosion does not undermine levees, and also to preserve or restore valuable riparian and aquatic habitats.

Approximately 13,800 feet of bank have been identified that either are eroding into the levee or are expected to undermine flood control levees before a long-term flood protection project for Sacramento can be completed. In addition, approximately 5,000 feet of existing bank protection needs repair. Construction of this new bank protection and repair work is proceeding under the authority for the Sacramento River Bank Protection Project (Flood Control Act of 1960, Public Law 86-645). A design report and an environmental impact statement are being prepared on this work.

Folsom Dam and Reservoir Flood Operations

The agreement by SAFCA and Reclamation for reoperation of Folsom Dam and Reservoir to increase flood protection to Sacramento will expire in 1999 unless renegotiated. The premise of the agreement was that a project to provide a long-term, high level of protection would be implemented during the period of the agreement or within a few years of its expiration. Under the without-project condition, the interim reoperation agreement is expected to be extended indefinitely. This assumption has two bases. First, it is unlikely that any increased level of protection obtained for Sacramento would later be reduced. In the absence of a new American River project, reoperation of Folsom and the 100-year level of protection it provides would be continued. Reoperation is cost effective, and it is expected that SAFCA would continue to work with Reclamation to maintain it. Second, SAFCA would have to mitigate for adverse hydraulic impacts of its local Natomas project. Reoperation would provide that mitigation cost effectively and would improve the reliability of much of the rest of the flood control system. The benefits, effects, and costs of long-term reoperation are discussed in chapter VII.

Folsom Dam and Reservoir are expected to be operated for flood control in the future, the same as it is today. During major storms, releases will be held to 115,000 cfs until the current gross pool (975,000 acre-feet) and about 50,000 acre-feet of surcharge storage (vacant space above the gross pool elevation) is full. For storms with greater inflow

volume, Folsom releases would be increased above 115,000 cfs in accordance with the emergency spillway release diagram.

SOCIOECONOMIC CONDITIONS

Land use in much of the flood plain area would remain essentially as it is today. In Natomas, however, much of the area likely would be converted from agricultural to urban uses. Growth would be expected in a small portion of south Sacramento south of Meadowview Road and north of the Beach Lake levee. Areas of growth would provide increased economic opportunities and generate a substantial need for new housing, additional water supply, increased sewage capacity, new schools, and other public infrastructure and services. Certain impacts to cultural resources would likely result from natural processes, including flooding, and urban expansion and vandalism.

Flooding from a 100-year or greater storm would significantly disrupt economic activity and the conduct of governmental business in Sacramento on a short-term basis. Property values in the developed portions of the flood plain would be depressed. Flooding would produce a significant short-term problem of solid waste disposal due to debris generation. Cultural resource sites would also be adversely affected by flooding.

The community of Auburn is expected to reach buildout under current plans by the year 2010 and would continue as the largest urban center in the area. Population centers in El Dorado County—primarily Cool, Pilot Hill, and Georgetown—east of Folsom Reservoir are expected to experience significantly higher rates of growth than the Auburn area. Land in the upper American River canyon area would remain in public ownership. Growth in the upper American River area would likely necessitate improved and additional transportation facilities.

Recreation use of Folsom Lake, the American River, and the American River Parkway is expected to increase. The County of Sacramento estimates that use of the parkway will increase from 5.5 million people in 1988 to about 7.5 million in 2000. Recreational use of Folsom Lake will increase from 2.1 million visitors currently to 3.4 million by the year 2000.

ENVIRONMENTAL RESOURCES

Water quality would likely remain generally the same as under current conditions. However, upstream water diversions and the effects of urbanization on discharges into downstream receiving waters could decrease water quality.

Anticipated growth would create new emission sources and make attainment of State and Federal standards for ozone, carbon monoxide, and suspended particulate matter more difficult. Compliance with the Sacramento Metropolitan Air Quality Management District's

air quality attainment plan would create sufficient offsets in developed areas of the region to accommodate new emission sources. Until California's implementation plan to meet attainment is approved by the Environmental Protection Agency, the Federal implementation plan must be utilized for compliance. Improvements in regional air quality might be made; however, Sacramento has failed to comply with three previous air-quality attainment plans.

Salinity requirements to protect various beneficial water uses in the Delta are established in the State Water Resource Control Board's Water Rights Decision 1485 (D-1485). Salinity standards are still being reviewed for the protection of selected estuarine habitat. In addition, a variety of electrical conductivity standards have been suggested for the protection of fish, wildlife, and agriculture. Water temperature in the Delta is an ongoing concern.

Hazardous and toxic waste sites that are considered to be a "serious threat" are slated for cleanup and/or further monitoring by one or more governmental efforts to address issues in the Sacramento area. Flooding from a 100-year or greater storm would result in significant contamination by sites that had not been remediated, adversely affecting water quality. Flooding would also affect fisheries and wildlife, including special-status species.

Vegetation in the upper American River canyon would remain much as it is today, with some revegetation in areas scarred by construction of the Auburn Dam foundation. Existing vegetation on private lands in the foothills would likely change as lands are converted to more dense residential-related uses.

CHAPTER IV

PLAN FORMULATION

This chapter summarizes the process and results of formulating flood protection alternatives for Sacramento. The flood damage reduction measures evaluated and flood protection alternatives developed from those measures are described in detail in Appendix D, Plan Formulation. Specific information on designs and cost estimates is contained in Appendix E, Designs and Cost Estimates, and in Appendix F, Real Estate.

PLAN FORMULATION PROCESS

The plan formulation process consists of these basic tasks:

- Establish specific objectives for implementing a plan to resolve the identified flood problems and, as possible, related water resources needs.
- Define constraints and criteria for formulating an implementable plan.
- Identify, document, and evaluate flood damage reduction and related measures to address the planning objectives.
- From the most workable measures, assemble, display, and evaluate an array of alternatives, consistent with planning constraints and criteria, to address the study objectives.
- Compare and evaluate the alternatives and select and display a plan for recommended implementation.

PLANNING OBJECTIVES

A serious flood problem exists in the Sacramento area. There is also the need for increased incidental recreation, water supply, hydropower, and fish and wildlife habitat in the study area. Based on these problems, needs, and opportunities, the following planning objectives were developed and used in the formulation of flood protection alternatives.

- Reduce flood damages in the Sacramento urban area from overflows of the American River and in Natomas. In this regard, the non-Federal sponsor's objective is a high level of protection (control of the 200-year or greater storm) from flooding along the American River with a reliability of achieving this level of protection equal to or greater than the reliability of the existing system.

- Enhance recreation opportunities in the study area incidental to the flood control objective.

- Develop opportunities for restoration of environmental resources along the American River consistent with the flood control objective.

- If possible, enhance water supply and hydropower opportunities at Folsom Dam and Reservoir and evaluate such opportunities in the basin incidental to the flood control objective.

- Contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive orders, and other Federal planning requirements.

PLANNING CONSTRAINTS AND CRITERIA

CONSTRAINTS

Fundamental to the plan formulation process is an understanding of the constraints on the current studies. The major constraints are:

- **Authorization** - The authority for the initial feasibility study and for this report established various constraints, as described in chapter I.

- **Study Area** - The principal area for which flood protection is being addressed is the lower American River, Natomas, and Dry Creek area. However, alternatives to protect this area and impacts of the alternatives could affect resources in the upper American River basin and as far away as Shasta Dam and the Sacramento-San Joaquin Delta.

- **Laws, Regulations, and Policies** - Numerous laws, regulations, Executive orders, and policies must be considered, including the National Environmental Policy Act, Fish and Wildlife Coordination Act, Clean Air Act, and Clean Water Act. These and other applicable requirements are discussed in the supplemental environmental impact statement.

CRITERIA

The planning process establishes these four criteria for consideration in formulating flood protection alternatives: (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability. These criteria and how they apply are described later in this chapter in the section on "Summary Comparison of Initial Array of Alternatives."

REEVALUATION OF FLOOD PROTECTION MEASURES

The FY 93 DoD Act and subsequent instruction from Congress directed the Corps to provide additional information on various flood protection measures described in the 1991 feasibility report for Congress' use in deciding on a long-term flood protection plan for Sacramento. This information included (1) a more detailed analysis of certain flood protection measures that did not include a flood detention dam and (2) a reevaluation of other measures dropped from consideration early in the feasibility study.

MEASURES

As a result of Congress' request, the Corps, State of California, SAFCA, and other organizations and individuals identified for evaluation several new and previously considered measures that could help increase flood protection to Sacramento. In general, these measures fall into three categories: (1) increase in the outlet efficiency of Folsom Dam and Reservoir, (2) increase flood releases from Folsom Reservoir, and (3) increase total flood control storage for the American River basin. In addition to measures to increase the level of flood protection, nonstructural measures aimed at reducing flood damages and loss of life were also reviewed. Measures reviewed and reevaluated are listed by category in table IV-1. Those measures retained for possible inclusion in flood protection alternatives are shown in the table in italics.

Increase Folsom Dam and Reservoir Outlet Efficiency

Nine measures were considered to increase the release capacity, or "outlet efficiency," of Folsom Dam and Reservoir. Folsom's ability to control large floods is severely limited by the capacity of the existing spillway and outlet works. Flood control releases are made over the spillway and through three power penstocks and eight river outlets in the dam. However, together the penstocks and outlets can release a maximum of only 36,000 cfs. Larger releases cannot be made until the reservoir reaches the spillway crest, and the full objective release of 115,000 cfs cannot be made until the reservoir is well above the crest. By this point the reservoir is already more than 75 percent full, and its ability to absorb inflow from a major rainstorm is severely diminished.

TABLE IV-1

Initial Screening of Flood Protection Measures

Measure	Frequency of Storm Controlled to Obj. Release (years)	Construction Cost ($ million)	Flood Control Benefits (B) vs. Costs [c]	Relative Impacts		Potential for Combining with Other Measures	Status
				Environmental	Socioeconomic		
Increase Folsom Dam and Reservoir Outlet Efficiency							
1. *Improved operational response time*	85	< 1	B > C	low	none	high	retained
2. Normalized use of auxiliary spillway	100	20	B > C	low	none	low	dropped
3. *Lower main spillway*	110	60	B > C	low	none	high	retained
4. Conjunctive use of existing river outlets and main spillway	100	5	B > C	low	none	low	dropped
5. *Enlarge river outlets*	105	40	B > C	low	none	high	retained
6. *New river outlets*	105	40	B > C	low	none	high	retained
7. Existing diversion tunnel	105	70	B > C	high	high	high	dropped
8. *New tunnel outlets:* *3 tunnels* *5 tunnels*	 110 110	 140 200	 B > C	 medium	 medium	 high	 retained
9. Early releases	85	N/A	N/A	low	none	low	dropped
Increase Folsom Dam Flood Releases							
1. *Levee modifications:* *130,000 cfs* *145,000 cfs* *180,000 cfs* *235,000 cfs*	 110 120 155 190	 260 350 500 815	 B ≤ C	 medium medium medium high	 low low low high	 high high high high	 retained retained retained dropped
2. Setback levees	155	6,700	B < C	very low	high	low	dropped
3. Flood control bypass south of Sacramento	200	2,100	B < C	high	high	low	dropped
Increase System Flood Storage							
1. *Flood detention dam*	250	728	B > C	high	low	low	retained
2. Existing upstream storage: 50 percent 100 percent	 85 85	 830 975	 B < C	 medium medium	 high high	 low low	 dropped dropped
3. Multiple small detention dams	105	900	B < C	high	low	low	dropped
4. Offstream storage - Deer Creek	200	1,600	B < C	high	high	low	dropped
5. *Modify Folsom flood space:* *475,000-670,000 ac-ft* *535,000-835,000 ac-ft*	 100 100	 120 170	 B > C	 low moderate	 moderate high	 high high	 retained retained
6. Raise Folsom Dam & Spillway: 17 feet 30 feet	 130 180	 460 660	 B < C	 medium	 medium	 low	 dropped
7. *Credit surcharge*	95	20	B > C	low	low	high	retained
8. Excavate Folsom Lakebed	130	1,400	B < C	medium	low	low	dropped
Non-Traditional (Nonstructural)							
Flood proofing, evacuation, restriction, and warning	N/A	high	low	low	high	medium	dropped

Increase Folsom Dam Flood Releases

The objective release from Folsom Dam is 115,000 cfs. The flood control storage space in Folsom Reservoir could be better managed—and large floods better controlled—if larger releases could be made. Larger releases would result in higher water-surface elevations downstream from Folsom Dam, requiring measures to safely pass the floodwaters through or around Sacramento and farther downstream in the Yolo Bypass or Sacramento-San Joaquin Delta. Three measures were considered.

Increase System Flood Storage

Folsom Reservoir is the only reservoir in the American River basin with storage space specifically dedicated to flood control. Several smaller reservoirs in the upper basin provide incidental flood storage. Additional flood storage for the basin could be obtained, either (1) at existing or new facilities upstream from Folsom Reservoir, (2) with modifications at Folsom Reservoir, or (3) with a new facility in an adjacent or nearby basin. Additional flood storage would increase Folsom Dam's ability to control large floods and, thus, improve flood protection for Sacramento. Eight measures were evaluated to increase flood storage for the American River system.

Nonstructural Measures

Most structural flood damage reduction measures are directed at the source of flooding. Their purpose is to change the direction of floodflows, decrease the area of inundation, alter the timing of floodflows, or store floodflows. In contrast, most nonstructural measures are directed at flood damage reduction of individual property, through the use of land use restrictions and other actions. Nonstructural measures fall into these broad categories:

- Flood Proofing - Flood proofing includes temporary or permanent closure of structures, raising existing structures, and constructing small walls or levees around structures.

- Flood Plain Evacuation - Flood plain evacuation involves either moving the structure and its contents to a flood-free site, or removing only the contents and demolishing the structure or using it for some other purpose.

- Development Restrictions - Development restrictions include zoning, subdivision regulations, and modification of building and housing codes to require that all future development is compatible with the flood threat.

- Flood Warning - Flood warning consists of flood forecasting; warning the population; evacuation before, during, and after a flood; and postflood reoccupation and recovery.

Those procedures are currently in force by a coordinated plan involving Federal, State, and community governments.

INITIAL SCREENING

The first step in the formulation of flood protection alternatives was to screen individual measures in order to identify those that would be most effective in reducing flood damages. Those measures were then combined in different ways to formulate a range of conceptual flood protection alternatives.

Screening Criteria

Each measure was compared to the without-project condition and to each of the other measures. Important evaluation factors were (1) technical feasibility, (2) level of flood protection provided, (3) cost, (4) environmental impacts, (5) effects on local communities, and (6) potential for combination with other measures to provide a higher level of flood protection.

Table IV-1 summarizes the results of the initial screening. Of the 20 measures considered, 9 were retained for possible inclusion in flood protection alternatives. Following are brief descriptions of the measures and explanations for either retaining or dropping them from further consideration. The measures which are retained are discussed first, then the measures which were dropped.

Measures Retained for Further Study

Improved Operational Response Time. This measure includes (1) replacing or modifying streamflow gages on each of the main forks of the American River to allow for telemetered operation and (2) expanding the flood-warning system along the lower American River. These features would improve the operating efficiency of the existing flood control system and were recommended in the Folsom Dam and Reservoir Flood Management Plan, prepared by the Corps and Bureau in March 1995. These features would not measurably affect the flood protection level, but they would significantly decrease the uncertainty in existing operations. For this reason and the low cost, this measure was retained for further analysis.

Lower Main Spillway. The five bays of the main spillway at Folsom Dam would be lowered 15 feet by removing the existing concrete from each bay and lowering the spillway crest from elevation 418 feet to 403 feet. Spillway releases could then be made sooner during a flood, thus increasing the effectiveness of the flood storage space behind the dam. The radial spillway gates would be replaced with new gates 42 feet wide and 65 feet high, or 15 feet higher than the existing gates, and the stilling basin below the spillway would be lengthened about 50 feet.

Lowering the spillway would be relatively expensive compared to some other measures; however, it would also provide a significant increase in flood protection, particularly if combined with increases in the objective release or in storage space dedicated to flood control.

Enlarge Existing River Outlets. The existing river outlets in Folsom Dam have a limited release capacity—about 28,000 cfs. Enlarging the outlets from 5 feet wide and 9 feet high to 6 feet wide and 12 feet high would almost double the capacity, increasing each outlet from 3,500 cfs to 6,900 cfs for a total increase of about 27,200 cfs. Enlargement would include pier construction, outlet reshaping, and air vents necessary for using the outlets and spillway simultaneously.

Enlarging the outlets would increase the operating efficiency of Folsom Dam, be cost efficient, and not affect the operation of Folsom for other purposes. If combined with other measures, it could significantly increase flood protection.

New River Outlets. Four new river outlets constructed below the flip bucket of the auxiliary spillway would increase Folsom's low-level outlet capacity by 25,200 cfs. The new outlets would be 6 feet wide and 12 feet high, extend about 210 feet through the dam, and have an individual capacity of about 6,300 cfs. A stilling basin would have to be constructed below the spillway to prevent erosion to the impact area downstream from the outlets.

As with enlarged outlets, new outlets would increase flood control releases from the dam, would be cost efficient, and would not affect the operation of Folsom for other purposes.

New Tunnel Outlets. From three to five parallel tunnel outlets could be constructed beneath the north abutment of Folsom Dam to significantly increase releases from the dam, even if the reservoir water-surface elevation were below the spillway crest. Each tunnel would be 23 feet in diameter and 2,200 feet long and release up to 20,000 cfs. Total releases would be 60,000 cfs for three tunnels and 100,000 cfs for five tunnels.

New tunnels would have greater construction impacts than the other measures to increase outflows from Folsom but were retained for further study because of the potential to improve the operation at Folsom and to be combined with other measures.

Levee Modifications. Increasing the objective release from Folsom Dam would result in higher water-surface elevations more frequently on the levees and banks of the lower American River. Because the materials used to build the original levees, including the foundations, were inconsistent, sustained flows above 115,000 cfs would likely cause levee failure if seepage and piping of water through the levees caused erosion or weakened the integrity of the levee foundations.

Four increased objective releases were analyzed: 130,000 cfs, 145,000 cfs, 180,000 cfs, and 235,000 cfs. The specific modifications required would depend on the objective release but would include:

- Slurry cutoff walls for levee seepage and stability control
- Raising of existing project and private levees
- New levees and floodwalls
- Levee-slope erosion protection from high flow velocities and wind-generated waves
- Raising of and modification to existing infrastructure
- Bridge raising
- Bridge abutment erosion (scour) protection

In addition, the Sacramento Weir and Bypass would be enlarged to convey the increased floodflows into the Yolo Bypass, and modifications would be made to Yolo Bypass and Delta levees to accommodate the increased flows.

Increasing the objective release from Folsom Dam would allow more efficient evacuation of flood inflows to the reservoir and increase the dam's ability to control outflows. Initial analyses indicate that increasing the objective release by itself is not economically feasible; however, when combined with other Folsom Dam measures, it could provide relatively high levels of flood protection to Sacramento.

The feasible limit to increased objective releases is about 180,000 cfs. Releases above 180,000 cfs could not be physically accommodated by an enlarged Sacramento Weir and Bypass, and levee work that would be required along the lower Sacramento River would not be cost-effective.

Flood Detention Dam. Construction of a flood detention dam on the North Fork American River near Auburn could control runoff from about two-thirds of the American River basin. Two dam sizes were evaluated in detail in the 1991 feasibility report. The smaller dam was 425 feet high, would create a flood detention area of 545,000 acre-feet, and would provide 200-year protection to Sacramento. This plan was reevaluated for the current studies to represent the detention storage measure. The plan has been modified, however, to increase the number of gates in the dam from 12 to 20. The additional gates would improve control of the flood pool behind the dam to reduce the environmental impact of the pool on the river canyon. With the gates open, more water could pass through the dam, resulting in less inundation of the canyon during frequent storms.

A detention dam could provide a high level of flood protection and would be cost effective. It would be the least costly of individual measures to provide 200-year or greater flood protection.

Modify Folsom Flood Space. The 1995 agreement between SAFCA and Reclamation to increase the seasonal flood space in Folsom Reservoir from 400,000 acre-feet

to a space varying from 400,000 to 670,000 acre-feet increased the dam's ability to control outflows to the 115,000-cfs objective release from about an 80-year storm to about a 100-year storm. This increase relies on a "credit" toward flood control of 200,000 acre-feet of space in upstream reservoirs. As this credited space is filled, however, the flood space allocation in Folsom will have to be increased proportionately, to a maximum of 670,000 acre-feet.

Two variable operation schemes to the current "400/670" operation were evaluated: 475,000 to 670,000 acre-feet and 535,000 to 835,000 acre-feet. Such changes would not require physical modifications to Folsom Dam. However, increases in the flood space would result in losses of project (Folsom) benefits such as water supply, hydropower, and recreation, and would affect the environmental resources of the area. Essentially, increases would trade water conservation storage in Folsom Reservoir for seasonal flood control storage.

The existing outlet configuration and objective release from Folsom limit increases in flood protection otherwise possible from reoperation levels greater than the current 400/670. Any increase in storage would be below the spillway elevation and thus would be very ineffective. However, if coupled with measures to increase outlet capacity and objective releases, more aggressive reoperation could significantly increase flood protection.

<u>Credit Surcharge Storage for Flood Control</u>. Folsom Reservoir has approximately 14.5 feet of freeboard above the gross pool elevation of 466 feet. Approximately 10 feet of this freeboard, equivalent to 50,000 acre-feet of storage, can be "encroached" during storms slightly greater than the design flood or to provide time for evacuation of water if very large storms are anticipated. This space above gross pool is called "surcharge" space.

More frequent and sustained use of surcharge space for flood control would require (1) changes to the release diagram for the auxiliary spillway, (2) changes to existing flood-warning plans, and (3) strengthening of the auxiliary dams and dikes at Folsom. Although crediting of surcharge storage for flood control would not significantly increase the level of protection, it is economically feasible and would have relatively few impacts. Therefore, it was retained for possible combination with other measures.

<u>Measures Dropped From Further Study</u>

<u>Normalized Use of Auxiliary Spillway</u>. The auxiliary spillway at Folsom Dam was designed for use during very large floods. More routine, or "normalized," use of the spillway would require modifying the river channel immediately downstream from the dam so large releases over the auxiliary spillway would result in little or no damage to the channel.

This measure would provide a modest increase in flood protection at fairly low cost. The major drawback, however, is that the measure would be effective only when the

water-surface elevation in the reservoir reached the spillway, when most of flood storage space has already been used. The measure would be less cost effective when combined with other measures to increase the capacity of the low-level outlets in the dam. Such other measures, as lowering the main spillway and modifying or constructing river outlets, would provide a greater return on investment.

Conjunctive Use of River Outlets and Spillway. Minimum modifications to the spillway and outlet works at Folsom would allow both facilities to be used simultaneously at their maximum capacity. The outlet modifications, however, are also part of the measure to enlarge the existing river outlets, which can be combined more effectively with other measures to provide higher levels of flood protection.

Modify Existing Diversion Tunnel. The diversion tunnel used during construction of Folsom Dam could be unplugged and retrofitted to make flood releases. Use of the tunnel would involve complex technical problems, and significant impacts would result from drawing down Folsom Reservoir during the construction period. Further, other measures to increase outflow from the dam for similar levels of flood control are less costly.

Early Flood Releases Based on Weather Forecast. The intent of this measure is to increase the operating efficiency of the flood control system at Folsom, and is considered in proposed operation changes for Folsom Dam and Reservoir as part of the Folsom Flood Management Plan and the without-project condition. However, use of long-range weather forecasts as a basis for making large releases to evacuate Folsom Reservoir many hours or days in advance of a large storm over the American River basin was dropped as a flood protection measure. The accuracy of long-range forecasting is very uncertain, and frequent prereleases from Folsom could have significant adverse impacts as losses of water that otherwise would be stored in the reservoir. Because the confidence to rely on long-range forecasting for early releases is low, the benefits of early releases are outweighed by the risk of adverse impacts.

Setback Levees. Increased releases from Folsom Dam could be accommodated by setting back the levee system along the lower American River. This would require (1) removing and reconstructing the levee on one bank or the other for the full length of the levee system; (2) acquiring many acres of residential, commercial, and industrial lands; (3) relocating many thousands of residential structures, several schools and apartment complexes, and numerous commercial and industrial properties; and (4) relocating roads and other infrastructure. This measure was dropped because of the high construction cost, relocation requirements, and major socioeconomic impacts.

Southern Bypass. Increased releases from Folsom Reservoir above the objective release of 115,000 cfs could be diverted to a flood control bypass system. This system would consist of gated outlet works at Mormon Island Dam, a concrete channel/tunnel system to convey water to the Deer Creek floodway, channel and levee modifications along

Deer Creek and the Cosumnes and Mokelumne Rivers, and floodways through the Delta to the San Joaquin River.

Diversion of some floodflows from the American River at Folsom Reservoir would improve Folsom's ability to control floodflows in the lower American to the objective release of 115,000 cfs. However, the estimated construction cost of the bypass system would be significantly greater than the economic benefits. Further, new levee and channel construction would result in many environmental and related impacts. Land and relocation requirements would also be high.

Use of Existing Upstream Storage. As much as 500,000 acre-feet of space in five of the larger existing reservoirs upstream from Folsom could be converted for flood control. The reservoirs are Loon Lake, Ice House, and Union Valley, owned by the Sacramento Municipal Utility District, and French Meadows and Hell Hole, owned by Placer County Water Agency. The reservoirs were built exclusively for water supply and power generation.

Based on estimates for other projects, modifications for flood control of the outlet works at the five reservoirs would cost between $10 million and $40 million depending on the needed capacity of the individual outlets. Acquisition of the storage space would cost between $350 million and $700 million. However, use of this space would not measurably increase flood protection to Sacramento because the reservoirs are located high in the drainage basin and thus control just a small portion of basin runoff. Because of the high cost, minimal increase in flood protection, and private ownership and use, this measure was dropped.

Multiple Small Flood Detention Dams. Fifteen small flood detention dams could be constructed in the American River basin to reduce peak inflows into Folsom Lake. Each dam would be about 100 feet high, control runoff from about 20 square miles, cover about 5 acres, and inundate about 200 acres. The dams would be ungated with sluices designed to capture peak runoff and store floodflows for up to 3 days.

These 15 dams could control peak runoff from about 15 percent of the basin and increase somewhat Folsom Dam's flood control ability. However, construction of 15 dams would significantly exceed the benefits derived. Several small dams could not provide the same or a similar level of protection provided by one large facility lower in the basin. Further, the cost associated with constructing several small facilities and the cumulative environmental impact from them would significantly exceed the cost and impact from one facility.

Offstream Storage on Deer Creek. Additional flood control storage could be provided by diverting floodwaters from the American River basin to the nearby Cosumnes/Mokelumne Rivers system. Floodflows would be temporarily stored in a new detention basin on Deer Creek and released into the Delta via the Cosumnes and Mokelumne

Rivers after flood peaks had passed on those rivers. Features for offstream storage on Deer Creek would include (1) outlet works consisting of about six-bays, radial-gate overflow section adjacent to the west side of Folsom Reservoir's Mormon Island Dam; (2) a connecting channel about 8 miles long from Folsom's outlet works to the detention dam on Deer Creek; (3) a flood detention basin on Deer Creek upstream from the confluence with Cosumnes River with a capacity of up to about 600,000 acre-feet; and (4) channel modifications along lower Deer Creek, Cosumnes River, and the Delta to contain flood releases from the dam.

Several combinations of increased storage space in Folsom Reservoir and sizes of detention facilities on Deer Creek were considered. It was found that offstream storage on Deer Creek would provide similar levels of flood protection to new storage in the American River basin—but at roughly three times the cost. Also, construction and operation of offstream storage would result in adverse environmental and related impacts and affect significant residential and commercial development occurring now and expected in the basin area. Diversion of floodwaters from the American River to the Cosumnes would create high flows and induce flooding in south Sacramento and San Joaquin Counties, some of which might not be possible to mitigate.

<u>Raise Folsom Dam and Spillway</u>. Folsom's flood control storage space could be increased by increasing the space above the reservoir's gross pool (elevation 466 feet). Folsom Dam would have to be raised, about 5 miles of wing dams and supplemental dams and dikes that fill in low spots around the reservoir perimeter would have to be raised and extended, and the spillway gates would be replaced with gates 65 feet high.

Two dam raises were analyzed—30 feet, a maximum, and 17 feet, the minimum needed to control the probable maximum floodflow. The 30-foot raise would increase storage by about 366,000 acre-feet and the 17-foot raise about 200,000 acre-feet. The additional space would be dedicated exclusively to flood control and would be used infrequently; for example, up to 7 days during a flood caused by a 50-year or larger storm.

Preliminary studies showed this measure to be not cost effective. The cost would be greater than for other storage measures that could provide similar increases in flood protection levels.

<u>Excavate Folsom Lakebed</u>. Excavation of the Folsom Reservoir lakebed would provide additional storage, but it would be prohibitively expensive for a small increase in flood protection. The space below the spillway is very inefficient for flood control, and even an additional 100,000 acre-feet of space would provide a very limited increase in flood protection.

<u>Nonstructural</u>. Nonstructural measures were considered in accordance with Corps' regulations. However, because of the large flood plain; high depths of flooding in much of the flood plain; and large numbers of residential, commercial, industrial, and institutional

structures in the flood plain; raising structures or removing them from the flood plain would not be economically feasible. Similarity, flood proofing measures such as constructing small walls or levees around structures would not be economically, socially, and environmentally feasible. Increased efforts in flood plain evacuation and local flood warning systems are being aggressively pursued under both with- or without project conditions in the Sacramento area by local and State agencies. Consequently, these measures were not formulated into a specific alternative.

POTENTIAL COMBINATIONS OF REMAINING MEASURES

The nine retained measures were grouped into four categories:

- Increase Folsom Dam and Reservoir outlet capacity
- Increase Folsom Dam objective release
- Increase system flood storage at Folsom
- Increase system flood storage upstream from Folsom

The number of possible combinations of flood control measures expands greatly when various sizes (objective release, levee heights, dam sizes, etc.) of each measure are considered. To focus on those potential combinations that appeared to be most effective, the number of measures or variations of measures to be combined was limited to a manageable range.

The four categories of measures were then arranged either alone or in combination with one or more of the remaining categories into the nine combinations listed below. However, no combinations were made that included both increased objective releases and new upstream flood storage. Measures in both of these categories are costly, and early indications were that combinations of them would not be incrementally feasible. The nine combinations are listed here; those ultimately retained for consideration in flood protection plans are shown in italics.

1 - Increase outlet capacity
2 - *Increase upstream flood storage*
3 - *Increase objective release and outlet capacity*
4 - Increase objective release and Folsom flood space
5 - *Increase outlet capacity and Folsom flood space*
6 - Increase outlet capacity and upstream flood storage
7 - *Increase Folsom flood storage and upstream flood storage*
8 - *Increase objective release, outlet capacity, and Folsom flood storage*
9 - Increase outlet capacity, Folsom flood storage, and upstream flood storage

Within these 9 combinations, 57 different combinations were made from individual flood protection measures. Following are descriptions of the nine combinations and why

they were either retained or dropped from development into flood protection plans. Those combinations retained are discussed first, then the combinations that were dropped.

Measure Combinations Retained

Increase Upstream Flood Storage (Combination 2). The larger of the two flood detention dams evaluated in the 1991 feasibility report would provide a very high level of protection (ability to control in excess of a 400-year storm) to Sacramento. With such a high protection level, the without-project variable operation of Folsom would no longer be practical without modifications to Folsom's outlet capacity. Thus, flood storage at Folsom would be returned to the "fixed" 400,000 acre-feet, and impacts on water supply, power, and recreation benefits would be avoided.

Increase Objective Release and Outlet Capacity (Combination 3). Several combinations to increase the objective release and outlet capacity at Folsom Dam were addressed. These combinations would significantly increase the level of protection over either category of measures considered separately. Except for combinations that include both new tunnel outlets and lowering the spillway, all the measures initially appeared to be economically feasible.

Because the various outlet works combinations would be more effective with increasingly higher objective releases, the 180,000-cfs release was used to compare the full range of outlet works modifications. With an objective release of 180,000 cfs, the maximum level of protection obtainable is greater than 200 years. It could be achieved with a number of combinations of outlet works, but the most cost effective would be enlarging the existing river outlets, constructing four new outlets, and lowering the spillway. The cost of new tunnel outlets would be greater than the combined cost of the three other measures. Because the benefits of new tunnels would be far overshadowed by the costs, combinations including the tunnels were not carried forward.

Increase Outlet Capacity and Folsom Flood Space (Combination 5). This combination would increase the outlet capacity by enlarging the existing river outlets, constructing new outlets, and lowering the spillway, and increase the flood space by either reoperating the reservoir more aggressively or using surcharge storage. This combination was retained primarily because it (1) is economically feasible and (2) could significantly increase the level of protection without a higher objective release from Folsom Dam and resultant downstream impacts.

Increase Folsom Flood Storage and Upstream Flood Storage (Combination 7). This combination consists of (1) either increasing reoperation of Folsom Reservoir or crediting surcharge space and (2) constructing a flood detention dam near Auburn. Earlier analyses showed that "variable" flood control rule curve operation at Folsom is not practicable with new upstream flood detention storage without increases in the outlet capacity

at Folsom, particularly as the variable space in Folsom is increased. Increased reoperation was therefore not considered further in combination with upstream storage.

Crediting of surcharge space to flood control is not practicable with the without-project variable flood control operation, so it was considered only in conjunction with a return to the fixed 400,000-acre-foot operation. The increment of storage provided by the surcharge space is economically feasible, so it was retained for further analysis. Returning to the fixed flood control operation at Folsom would eliminate the adverse impacts of reoperation on water supply, power generation, and recreation in Folsom Reservoir and the CVP.

Increase Objective Release, Outlet Capacity, and Folsom Flood Storage (Combination 8). This combination could control from about a 150-year storm to significantly greater than a 200-year storm. However, those variations controlling greater than a 200-year storm are generally impracticable because of the significant drawdown periodically required of Folsom Reservoir. This combination, incorporating the three categories of measures, is generally economically feasible. However, when evaluated incrementally and compared to a combination of just outlet capacity and increased flood space, the addition of the increased objective release is not economically feasible. Nonetheless, this combination could provide the greatest increase in flood protection without construction of new flood detention storage upstream from Folsom.

Measure Combinations Dropped

Increase Outlet Capacity (Combination 1). With the existing objective release of 115,000 cfs, increasing the outlet capacity of Folsom Dam does not have an appreciable effect on the level of protection. Individual measures to increase capacity could control storms ranging in magnitude from about 100-year to 110-year return frequencies. Combination of the measures, regardless of the number or mix of measures, would control a maximum of about a 110-year storm. Because none of the mixes would add more protection than a single measure, the additional costs are not justified and the combination was dropped.

At the existing objective release, outlet capacity is not the principal controlling factor in operating the reservoir. An increase in outlet capacity would be effective when combined with increases in the objective release or increased storage below the spillway. Outlet modifications were thus dropped as a stand-alone combination but are addressed in conjunction with other types of measures.

Increase Objective Release and Folsom Flood Space (Combination 4). Two measures increasing flood storage space were considered in combination with three increases in the Folsom objective release. First, two reoperation levels—475,000 acre-feet and 535,000 acre-feet in Folsom plus 200,000 acre-feet upstream in private reservoirs—were combined with three objective releases—130,000 cfs, 145,000 cfs, and 180,000 cfs. None of these combinations provided enough benefits to offset the high costs of increasing the

objective release. In addition, more flood storage in Folsom would be very ineffective with the existing outlet capacity. Almost no additional protection would be provided by 60,000 acre-feet of additional storage below the spillway elevation.

Combining surcharge credit with increased objective releases proved to be impracticable under the variable flood control operation. A hydraulic model was used to determine flood protection level. Storms were routed through the flood control system, assuming 400,000 acre-feet of space in Folsom and 200,000 acre-feet upstream. Then the amount of space required in Folsom without the upstream storage was determined. With increased objective releases, Folsom Reservoir would have to be drawn down to provide between 800,000 and 965,000 acre-feet of flood storage. At these storages, the reservoir would be essentially empty.

Surcharge credit was then analyzed in combination with the increased objective releases using the fixed seasonal flood space of 400,000 acre-feet. Even with the benefits attributed to restoration of resources lost with the variable flood control operation, this combination was not economically feasible.

Increase Outlet Capacity and Upstream Flood Storage (Combination 6). As discussed, the 400/670 flood control operation would not be practicable in combination with large flood detention storage upstream without an increased outlet capacity at Folsom. With increased outlet capacity, a variable operation combined with new storage upstream would be possible—but much less efficient. Additional space in Folsom (from 725,000 to 750,000 acre-feet) would be required when no space was available in the private reservoirs upstream. With the increased outlet capacity and upper range of reoperation, this combination could significantly increase flood protection. However, increased outlet capacity is incrementally feasible only with new storage (545,000-acre-foot detention reservoir).

This combination was also analyzed with the fixed flood control space (400,000 acre-feet) in Folsom Reservoir. Increasing the outlet capacity at Folsom would provide some increase in protection over upstream storage alone, but the incremental costs of the outlet modifications would be significantly greater than the benefits. Because the addition of increased outlet capacity would not be cost effective in combination with the full range of new flood detention storage, it was not considered further. However, the concept was retained for use in a sensitivity analysis of new upstream storage plans.

Increase Outlet Capacity, Folsom Flood Storage, and Upstream Flood Storage (Combination 9). In general, increased reoperation at Folsom is not practicable in combination with new upstream storage. However, a combination to increase both outlet capacity and reoperation at Folsom improves the efficiency of the increased Folsom storage sufficiently to combine these measures with a new detention dam upstream. Even so, new upstream storage would provide such a high level of protection that the increased benefits of the Folsom modifications would not be economically feasible. One exception to this would be a moderate increase in Folsom storage (475,000 acre-feet to 610,000 acre-feet) and the

545,000-acre-foot detention dam at Auburn. With either higher levels of reoperation or larger amounts of new storage, the outlet modifications would not be incrementally feasible. For the higher levels of flood control, the flood damage reduction benefits achieved would be fairly small. This measure combination was thus dropped from plan formulation analysis, but retained for sensitivity analyses of flood detention plans.

Crediting of Folsom surcharge space with outlet modifications and new upstream storage might be economically feasible at lower levels of upstream storage, but not through the full range considered. Therefore, it was not considered further in plan formulation plans, but was retained for use in a sensitivity analysis of new upstream storage.

FINDINGS

The screening of flood protection measures and combinations of measures showed that flood protection for Sacramento can be improved in either of two ways:

- New flood detention storage upstream from Folsom Reservoir
- Modifications at Folsom Dam and Reservoir and larger flood releases downstream

Some potential exists to combine new upstream storage with limited modifications at Folsom (including use of surcharge space) or a combination of increased reoperation and outlet capacity. However, because these modifications would not contribute substantially to increased flood protection when combined with new storage, they were not included in the development of new-storage plans. Folsom modifications were considered, however, in sensitivity analyses of new-storage plans to determine whether modification components would be incrementally justified.

INITIAL FLOOD PROTECTION PLANS CONSIDERED

PLAN CONCEPTS

Alternative flood protection plans displayed in the 1991 feasibility report were formulated on the basis of estimated level of flood protection: 100-, 150-, 200-, and 400-year. The level of protection was defined as the "return period" (in years) of the largest storm for which a plan could control Folsom Dam's peak outflows to the specified objective release. An implicit assumption in the comparison of plans was a high reliability that the structural components of each plan would provide the stated level of flood protection.

The overall goal of plan formulation for the current studies is still to develop alternative plans that can provide a high level of flood protection for Sacramento. However, the basis for developing plans has been shifted to meeting specific objectives identified by

various interest groups rather than to achieving specific levels of protection. These objectives include providing a significantly increased level of protection to Sacramento without new upstream storage, minimizing environmental impacts, and maximizing use of the existing flood control system, as well as the Federal objective of maximizing the return on funds invested in flood control projects (NED objective).

Level of protection is still an important factor in comparing the accomplishments of the various plans, but it was not used as the basis for developing the plans. Level of protection is also defined differently—as the probability of flooding due to levee failure—and is estimated using risk-based analytical techniques.

In addition to the No-Action Plan, four basic categories of flood protection plans were identified in cooperation with State and local interests. The categories and the alternative plans evaluated within them are:

- No Action
- Feasibility Report Recommended Plan
  - Equivalent Storage Plan
  - 200-Year Storage Plan
- High Level of Protection Without a Detention Dam
  - Maximum Objective Release Plan
  - Moderate Objective Release Plan
  - Minimum Objective Release Plan
  - Folsom Stepped Release Plan
- Increased Flood Protection With Minimum Impacts
  - Folsom Flood Storage Space Increase Plan
- National Economic Development (NED) Plan
  - Feasibility Report NED Plan

The initial range of alternative plans was presented in the November 1994 Alternatives Report. That report was used to obtain information from potential sponsors and other interest groups on a preferred plan or direction for providing flood protection to Sacramento. The results of public workshops and hearings were used to refine and modify alternatives included in the initial array and, ultimately, to narrow these alternatives to final candidate plans.

INCREMENTAL PROTECTION FOR NATOMAS

When SAFCA's local levee project in Natomas is completed, that area will have a higher level of protection than the rest of the Sacramento area. Under the without-project condition, Natomas would have about 1 chance in 140 of flooding due to levee failure.

SAFCA's Natomas project does not include any modifications to the east levee of the Sacramento River between Verona and the mouth of the American River. This east levee forms the western border of Natomas, and it is the weakest reach in the Natomas levee system. By raising portions of the east levee and strengthening existing stability berms, the PNP (probable nonfailure point) for the Natomas levees could be raised 2 feet to reduce the probability of flooding to about 1 chance in 435. Except for the Natomas Cross Canal, which has a probability of flooding of about 1 chance in 400, the rest of the Natomas levees have a probability of flooding of less than 1 chance in 500. The necessary Natomas work involves raising about 10 miles of the east levee as much as 3 feet, strengthening 12 miles of levee by raising the existing stability berm, and relocating various facilities. Benefits for the Natomas work are limited by the level of protection provided at the NCC. On an incremental basis, these levee modifications are feasible and are included in all of the plans described in the following sections.

PLAN DESCRIPTIONS

Following are descriptions of the flood protection plans considered, including features, accomplishments, estimated costs, impacts, and benefits.

No Action

The No-Action Alternative is the same as the without-project condition and describes the likely changes in the study area if no Federal flood protection project is implemented. No Action serves as the baseline against which the impacts and benefits of the action plans are evaluated. Additional information on the No-Action Alternative is contained in chapter V.

Feasibility Report Recommended Plan

The flood detention dam recommended in the 1991 feasibility report was a 425-foot-high dam on the North Fork American River with a detention capacity of 545,000 acre-feet. Two variations of this dam were evaluated, with modifications to reflect changed conditions since 1991. The Equivalent Storage Plan is a 435-foot-high dam with modified outlets to improve operating efficiency and provide a higher level of protection. The 200-year Storage Plan is a smaller dam that would provide a level of flood protection (using risk-based analysis) similar to the level described in the feasibility report.

Equivalent Storage Plan.

General Description. This plan is similar to the plan recommended in the 1991 feasibility report: a roller-compacted concrete flood detention dam 435 feet high with a capacity of 545,000 acre-feet to be constructed upstream from Folsom Reservoir on the

North Fork American River near Auburn. The principal features of this plan are summarized in table IV-2.

The main difference between the Equivalent Storage Plan and the feasibility report plan is the configuration of the outlet works. The newer plan has 20 gated outlet sluices instead of 12 ungated sluices. The larger number of sluices would allow smaller, more frequent floods to pass through the dam without backing up water. The gates in the sluices would be used to control the drawdown rate of large floods to reduce the potential for sloughing of the canyon walls. The gates would not be used to permanently store water in the detention area. A description of the gates and their benefits in reducing impacts on vegetation is included in Appendix G, Gating and Expandability Report.

In most years, no water would pool behind the dam, and pooling during a major storm would be for short durations. For example, during a 5-year storm (20 percent chance of occurring in any year), water would pool to a depth of about 35 feet at the dam for less than 1 day. During a 100-year storm (1 percent chance in any year), the pool depth at the dam could reach about 340 feet for 1 day. The total time for the detention area to fill to this depth at the dam and then empty would be about 15 days. The chance of this occurrence is about 64 percent over the 100-year period of analysis.

Periodic inundation of the canyon upstream from the dam would interrupt traffic on Highway 49 and, to a lesser extent, on Ponderosa Way. The frequency of inundation and potential for road damage and the attendant impacts on commuters, recreationists, and emergency vehicles would warrant relocation of Highway 49. The relocation would comprise a two-lane bridge across the American River as close as practicable to the existing highway alignment at each side of the canyon. The bridge would be at about elevation 1,000 feet. Ponderosa Road would be inundated infrequently and has significantly less use. Work would be done on the bridge and approaches to allow Ponderosa Way and bridge to withstand periodic inundation.

With this plan, the flood control storage space in Folsom Reservoir would revert from the variable 400/670 reoperation to the fixed 400,000 acre-feet of seasonal storage space.

With new flood storage upstream, the existing objective release at Folsom would control larger floods, thus reducing floodflows in the lower American River and areas downstream. Because the levees in these downstream areas would not be subjected to higher releases for a given magnitude of flood, their reliability would be improved. Therefore, no hydraulic mitigation features would be required.

The plan includes work along the east levee of the Sacramento River to maximize the level of protection for Natomas. This includes raising about 10 miles of levee a maximum of 3 feet and strengthening about 12 miles by raising the existing stability berm on the landward side of the levee.

TABLE IV-2

Summary of Initial Flood Protection Alternatives

Alternative	No-Action Alternative [1] (Without-Project Condition)	Feasibility Report Recommended Plan		High Level of Protection without Flood Detention Dam				Minimum Impact Plan	NED Plan
		Equivalent Storage	200-Year Storage	Maximum Objective Release	Moderate Objective Release	Minimum Objective Release	Folsom Stepped Release	Increase Folsom Flood Space	Feasibility Report
Flood protection (chance of flooding)	1 in 100	1 in 270	1 in 200	1 in 300	1 in 240	1 in 200	1 in 235	1 in 160	1 in 435
Probability of passing 200-year storm (%)	16	82	65	83	70	62	68	50	95
Features									
Folsom Dam & Reservoir									
Flood control space (ac-ft) [2]	400,000/670,000	400,000	400,000	475,000/810,000	475,000/725,000	475,000/670,000	400,000/670,000	475,000/655,000	400,000
Objective release (cfs)	115,000	115,000	115,000	180,000	145,000	130,000	145/180,000	115,000	115,000
Lower Folsom spillway 15 feet	No	No	No	Yes	Yes	Yes	Yes	Yes	No
Outlets (No. of gates & capacity, cfs)	8 & 30,000	8 & 30,000	8 & 30,000	12 & 100,000	12 & 100,000	12 &100,000	8 & 70,000	12 & 100,000	8 & 30,000
Lower American River									
American River design capacity (stage, ft)									
Probable nonfailure point	44.5	44.5	44.5	51	49	47	51	44.5	44.5
Probable failure point	47.5	47.5	47.5	52	50	48	52	47.5	47.5
Stabilize/modify levees (mi)	0	0	0	29	28	25	29	0	0
Raise/modify bridges	0	0	0	3	3	1	3	0	0
Downstream American River									
Modify Sacramento Weir & Bypass (ft)	0	0	0	2,700	1,000	600	1,000	0	0
Stabilize/modify levees (mi)	0	0	0	76	52	43	52	0	0
Natomas - east bank Sacramento River									
Stabilize/modify levees (mi)	0	12	12	12	12	12	12	12	12
Upstream storage									
Storage space (ac-ft)	0	545,000	380,000	0	0	0	0	0	894,000
Dam height (ft)	0	435	399	0	0	0	0	0	508
Flood operation gates	0	20	20	0	0	0	0	0	20
Raise/modify bridges	0	2	2	0	0	0	0	0	2
Costs ($ million) [3,4]									
First cost	60	746	670	758	655	533	539	296	872
Net annual benefits	23	36	25	24	19	22	24	28	45

[1] The no-action alternative displays costs and benefits of going from the baseline to the without-project conditions. All other "action" alternatives are compared to this no-action alternative.
[2] Single number is constant flood space; 400/670, for example, is variable space between 400,000 and 670,000 acre-feet.
[3] Costs based on October 1995 price levels, 7⅝% interest rate, and 100-year project life; costs include water, power, and recreation costs above 400,000/670,000 reoperation.
[4] Costs and net benefits shown are only to reflect relative differences. Costs and benefits for candidate plans are significantly different.

Environmental and Related Impacts and Mitigation. Construction of the detention dam, relocation of Highway 49, and operation of the dam would result in a loss of vegetation. These losses would be scattered throughout the inundation zone, would occur over the 100-year project life, and would affect the mix of age groups present in an area rather than occur as a dramatic clearing of vegetation. Vegetation losses would be primarily in oak woodland, chaparral, mixed conifer forest, and riparian shrub-scrub communities. Wildlife in the canyon would be affected by inundation of their habitat.

Mitigation for the loss would involve acquiring and improving land in the American River canyon and along the Yuba River. Land in the canyon inundation zone would be incorporated into an adaptive management plan that would include an annual monitoring program to identify impacts over time as the dam was operated for flood control and evaluation following major floods.

Potential habitat loss due to levee work along the Sacramento River at Natomas would be replaced by reseeding all construction areas after completion of the work. The main impacts of the levee work would be temporary disruption to local traffic.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from about 1 chance in 100 to 1 chance in 270. Over 50 years, the chance of flooding would be reduced from about 39 percent to 17 percent. The plan would also result in benefits to the CVP and others from offsetting impacts associated with reoperation of Folsom Dam and Reservoir for flood control. Levee work on the Sacramento River levee at Natomas would reduce the probability there of flooding from levee failure from 1 chance in 14 to 1 chance in 400.

A preliminary estimate of first (construction) costs for this plan is $746 million. Resulting net average annual flood damage reduction benefits are $36 million. It is important to note that this cost and benefit information was significantly updated in formulation of candidate plans in chapter V. However, the relative difference between the costs and benefits are similar.

200-Year Storage Plan.

General Description. Flood protection to the 200-year level or greater has been defined by the State of California and SAFCA to be essential and a minimum need for the Sacramento area because of the catastrophic loss of life and property that would result from levee failure during floods larger than the existing system can safely handle.

The dam would be 399 feet high and create a detention capacity of 380,000 acre-feet. As with the Equivalent Storage Plan, the gates in the outlet sluices would be operated during floods to reduce storage during fairly frequent floods and retard the drawdown rate of the flood pool during large floods. Highway 49 would be relocated, and the Ponderosa Way bridge would be modified to withstand inundation. The flood control storage space in

Folsom Reservoir would revert to the fixed 400,000 acre-feet of seasonal space. The plan would generally have a beneficial effect on downstream levee reliability, and no hydraulic mitigation features would be required. Work on the Sacramento River east levee would optimize the level of protection in Natomas. The basic features of the plan are summarized in table IV-2.

Environmental and Related Impacts and Mitigation. Construction and operation of the dam would have impacts in the American River canyon similar to those with the Equivalent Storage Plan. However, the smaller detention area would result in less impacts and mitigation required.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from about 1 chance in 100 to 1 chance in 200. Over 50 years, the chance of flooding would be reduced from about 39 percent to 22 percent. The plan also would benefit the CVP and others by offsetting impacts associated with reoperation of Folsom Dam and Reservoir for flood control. Work on the Sacramento River levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in 140 to about 1 chance in 400.

The estimated first cost for this plan is $670 million and net average annual benefits are $25 million.

High Level of Protection Without a Detention Dam

This category focuses on providing the highest level of flood protection possible without constructing a detention dam near Auburn. Plans in this category concentrate on a combination of (1) increases in Folsom flood storage, (2) modifications to Folsom Dam's outlet works, and (3) increases in the objective release from Folsom. Even though the analysis of measure combinations showed that increased objective releases are not incrementally feasible, combinations that include them yield total benefits that exceed total costs of the work. So in order to obtain higher levels of protection, these plans include all three types of measures.

This category has four plans:

- Maximum Objective Release Plan (180,000 cfs)
- Moderate Objective Release Plan (145,000 cfs)
- Minimum Objective Release Plan (130,000 cfs)
- Folsom Stepped Release Plan (145,000/180,000 cfs)

The first three plans were evaluated in the November 1994 Alternatives Report. Following public review of the report, some changes were made to the storage component of each of the original plans, and the Folsom Stepped Release Plan was added. This new plan combines features of the Maximum and Moderate Objective Release Plans.

All of these plans include recreation facilities and environmental restoration features. Because of the major modifications required to downstream levees, these plans provide significant opportunities for developing floodway recreation and restoration. Recreation and environmental restoration are not included in any of the other plans considered in this report because those plans include only minor work along the lower American River.

Maximum Objective Release Plan.

General Description. The primary operational goal of this plan is to increase the objective release from Folsom Dam from 115,000 cfs to 180,000 cfs, the maximum release feasible. The plan is made up of these main features:

- Increase objective release to 180,000 cfs
- Increase flood storage to a variable 475,000/810,000 acre-feet
- Credit surcharge space for flood control
- Increase outlet capacity by (1) lowering the main spillway, (2) enlarging the eight existing river outlets, and (3) constructing four new outlets below the auxiliary spillway
- Modify levees and related features downstream to accommodate the larger objective release
- Construct recreation and environmental restoration features along the lower American River
- Modify the east-bank levee of the Sacramento River at Natomas

The features of this plan are summarized in table IV-2 and described in more detail in the following paragraphs.

Folsom Dam and Reservoir. Increasing flood storage in Folsom Reservoir is a very cost-effective way to increase flood protection for Sacramento. In this plan, seasonal flood storage in Folsom would range from a base level of 475,000 acre-feet to a maximum of 810,000 acre-feet. If the creditable space available for flood control in the upstream reservoirs was 200,000 acre-feet (the maximum), the space requirement in Folsom would be 475,000 acre-feet. If the available space upstream was less than 200,000 acre-feet, then the space requirement in Folsom would be proportionately greater. And if no space was available in the upstream reservoirs, the requirement in Folsom would be 810,000 acre-feet.

Studies of various reoperation levels have shown that increasing the seasonal flood storage in Folsom to about 500,000 acre-feet would have relatively minor impacts on water supply, power generation, recreation, and environmental resources. To help minimize such impacts, a slightly lower base reoperation level of 475,000 acre-feet was selected for this plan (as well as the Moderate and Minimum Objective Release Plans). The majority of impacts from variable reoperation are attributable to the base storage volume reached each year. In most years, storage greater than the base volume would not be required.

Additional storage space at Folsom could be credited to flood control by making structural and operational changes to use more frequently the surcharge space above the flood control pool. The requirements would be (1) enlarging the auxiliary spillway gates and raising the impervious cores of Mormon Island Dam and dikes 5 and 7 to elevation 480.5 feet to control higher water surfaces and (2) modifying the auxiliary spillway release diagram and emergency evacuation plans to improve downstream safety. These modifications would allow the reservoir to operate about 6 feet higher before emergency releases would be required.

Lowering the five bays of the main spillway by 15 feet and replacing the operating gates would permit higher reservoir releases during a flood, allowing more efficient use of the storage space. The higher releases would require lengthening the stilling basin 50 feet. The eight existing river outlets would be enlarged from 5 feet wide and 9 feet high to 6 feet wide and 12 feet high, and other modifications would be made so the spillway and enlarged outlets could be used at the same time at their full capacities. Four new outlets, each 6 feet wide and 12 feet high, would be excavated through the dam below the auxiliary spillway at the same elevation as the upper tier of river outlets in the main spillway. These outlets would increase the release capacity below the spillway crest. Together, the enlarged and new river outlets would increase the total outlet capacity from about 28,000 cfs to about 80,000 cfs (with the water surface in the reservoir at the top of the gross pool elevation). An additional release of 8,000 cfs would be made through the power penstocks.

<u>Main Stem American River</u>. Increasing the objective release to 180,000 cfs would require constructing approximately 2 miles of new levee and 2 miles of new floodwall along the lower American River, raising 14 miles of levee, and modifying 26 miles. The PNP (probable nonfailure point) would be increased to a stage of 51 feet at H Street; the PFP (probable failure point) would be at 52 feet. The PNP and PFP are used in the R&U (risk and uncertainty) procedures to determine the likelihood of levee failure.

Levee raising and erosion protection would be done on the waterside of the levees; thus, little right-of-way would be required. To remedy levee seepage and stability problems, slurry cutoff walls would be constructed (since space is limited on the landside of the existing levees). The slurry wall construction would have minimal impacts on the surrounding environment. Sumps, pumping facilities, pipes, and other infrastructure along the American River would need to be relocated or modified as a result of the higher design water-surface elevation. In addition, three bridges would be raised above the design water surface.

<u>Downstream from American River</u>. By improving the flow-carrying capacity of the lower American River, more water would flow past the mouth of the river during storms that otherwise could have resulted in levee failure and flooding of Sacramento. This additional volume of water would affect the reliability—or ability to contain higher flows—of the flood control facilities downstream from the mouth. To offset this potential impact, the Sacramento Weir would be lengthened about 2,700 feet, the Sacramento Bypass would be widened 2,700 feet, and 1.5 miles of levee along the south side of the bypass

would be raised. This work would be more cost effective than strengthening and raising levees along the lower Sacramento River.

The majority of the increased flows (65,000 cfs) from the American River would be directed through the Sacramento Weir and Bypass into the Yolo Bypass, which has a design capacity of between 300,000 and 500,000 cfs. To offset the impacts of the higher flood stages from the American River, the Yolo Bypass levees would be modified so they would have the same reliability as they would under the without-project condition. The necessary work is termed "hydraulic mitigation" and would include raising about 58 miles of levee, strengthening 41 miles, and constructing 3 miles of new levee. Also, one bridge in the bypass would be modified.

Natomas. Modifications similar to those discussed in the previous plans would be made along the east levee of the Sacramento River to optimize the level of protection for Natomas.

Due to the extensive work in the lower American River area, opportunities exist to include features for enhancing recreation and restoring environmental resources in the American River Parkway. Day use recreation sites and new pedestrian/bike trails will help meet a growing need for new facilities in Sacramento. Development of wetland and riparian habitats will help to restore environmental values that have degraded over time since construction of Folsom Dam and the growth of Sacramento. Additional details on these features are discussed under the candidate plans and are shown in plate 9.

Environmental and Related Impacts and Mitigation. Increasing reoperation of Folsom to a variable 475/810 would likely not have significant impacts on environmental resources. The reservoir would be drawn down to provide at least 475,000 acre-feet of space from mid-November to mid-March, lowering the water surface about 10 feet from the without-project condition under most situations. This reduction would have some effects on delivery of local water supplies and on hydropower generation. (See chapter VI.) The additional flood storage capacity would also result in an average annual net reduction of about 13,000 acre-feet in water deliveries of the CVP and SWP. Because the drawdown would be during winter, recreation impacts would be few. The maximum drawdown would be 810,000 acre-feet, depending on the storage available in upstream reservoirs.

Mitigation for the water-supply reduction would consist of either replacing the lost water-delivery capability or reaching agreements with water users to consider alternate solutions. Power losses would be repaid by the project sponsor on an annual basis. Measures under the SAFCA/Reclamation reoperation agreement would continue to mitigate for impacts on fisheries, cultural resources, and recreation.

Work to increase the use of surcharge storage space in Folsom would not have significant impacts. Raising the impervious core of Mormon Island Dam and dikes 5 and 7 would entail removal of materials from the tops of those structures and temporary stockpiling

on existing grassland habitats. These areas would be reseeded with native grasses when construction was completed. The work could be timed so that the reservoir would not need to be drawn down, thus avoiding impacts to reservoir and downstream fisheries. Temporary construction impacts of noise, air quality, and traffic increases would be managed by using proper vehicle maintenance and other best management construction practices. Enlarging the auxiliary-spillway gates would be done concurrently with other outlet modifications.

Construction of outlet modifications at Folsom Dam (main spillway, existing river outlets, and new outlets) would have minimal impacts on natural resources at the dam. Noise increases and impacts to air quality would be mitigated with proper vehicle maintenance and sound barriers.

Improvements to the levee system along the lower American River and work along the Sacramento River levee at Natomas would have impacts as described for the Equivalent Storage Plan.

Widening the Sacramento Bypass would require acquisition of 622 acres of agricultural fields and grasslands. Construction areas for the new levees required would be reseeded to native vegetation and the agricultural areas allowed to revert to grassland vegetation. Improvements to levees in the Yolo Bypass would affect 168 acres of habitat (150 acres of riparian and wetland areas and 18 acres of upland habitats). Approximately 251 acres of habitat improvements would be made in the Yolo Bypass, on Liberty Island, and near the Cache Creek settling basin to mitigate for losses in the Yolo Bypass. Grassland acres disturbed for levee improvements would be reseeded with native vegetation.

<u>Accomplishments and Costs</u>. This plan would reduce the probability of flooding from levee failure in any given year from about 1 chance in 100 to 1 chance in 300. Over 50 years, the chance of flooding would be reduced from about 39 percent to 15 percent. Modifications to the Sacramento River levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in 140 to about 1 chance in 400.

The estimated first cost for this plan is $758 million. Net annual benefits are estimated at $24 million.

<u>Moderate Objective Release Plan</u>.

<u>General Description</u>. The Moderate Objective Release Plan is less aggressive than the Maximum Objective Release Plan. The Moderate Release Plan would (1) increase the objective release from Folsom to 145,000 cfs, (2) increase flood storage to a variable 475,000/725,000 acre-feet, and (3) modify levees and related features downstream to accommodate a 145,000-cfs objective releases. The plan also includes measures to increase the outlet capacity at Folsom Dam, recreation and environmental restoration features along the lower American River, and modifications to the east-bank levee of the Sacramento River

at Natomas. Table IV-2 summarizes the basic features of this plan. The main differences between this plan and the Maximum Objective Release Plan are discussed here.

Increasing the objective release to 145,000 cfs would require constructing about 1.5 miles of new levee and 1.7 miles of new floodwall, raising 9 miles of levee, and modifying 26 miles along the lower American River. The PNP would be increased to a stage of 49 feet at H Street, 3 feet above the 145,000-cfs stage. The PFP would be raised to 50 feet. Slurry cutoff walls would be used to strengthen levees, and interior drainage facilities would be relocated or modified. Three bridges would be either raised above the PNP elevation or modified to withstand rare floods.

Work downstream from the American River would include widening the Sacramento Bypass 1,000 feet, lengthening the Sacramento Weir 1,000 feet, and constructing 2 miles of new levee in the Yolo Bypass, raising 26 miles of levee, strengthening 38 miles, and modifying a Yolo Shoreline Railroad bridge over the Tule Canal.

Environmental and Related Impacts and Mitigation. Less levee modification would reduce impacts in the lower American River. Widening the Sacramento Bypass and modifying levees in the Yolo Bypass would affect nearly 130 acres of significant habitat, including emergent marsh and riparian systems. Mitigation would include planting riparian and upland habitat along the lower American River and in the Yolo Bypass. The seasonal flood storage capacity in Folsom Reservoir would result in water supply and hydropower impacts similar to those in the Maximum Objective Release Plan.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from about 1 chance in 100 to 1 chance in 240. Over 50 years, the chance of flooding would be reduced from about 39 percent to 18 percent. Modifications to the Sacramento levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in 140 to 1 chance in 400.

The estimated first cost for this plan is about $655 million. Estimated net annual benefits are $19 million.

Minimum Objective Release Plan.

General Description. This plan is similar to the Maximum and Moderate Objective Release Plans, but less aggressive. The Minimum Objective Release Plan would (1) increase the objective release from Folsom to 130,000 cfs, (2) increase Folsom flood storage to a variable 475,000/670,000 acre-feet, and (3) modify levees and related features downstream to handle the 130,000-cfs release. The plan also includes measures to increase the outlet capacity at Folsom Dam, recreation and environmental restoration features along the lower American River, and modifications to the east-bank levee of the Sacramento River at Natomas. Table IV-2 summarizes the basic features of this plan. The main differences between this plan and the Maximum and Moderate Release Plans are discussed here.

Increasing the objective release to 130,000 cfs would require constructing about 1 mile of new levee and 2 miles of new floodwall along the lower American River, raising 1 mile of levee, and modifying 22 miles. The PNP would be increased to a stage of 47 feet at H Street, an increase of 2.5 feet over the 130,000-cfs stage. The PFP would be 48 feet. Slurry cutoff walls would be used to strengthen levees, and interior drainage facilities would be relocated or modified. The right trestle of the Union Pacific Railroad bridge would be modified to resist higher inundation levels, but two other bridges would not have to be raised.

Work required downstream from the American River would include widening the Sacramento Bypass 600 feet, lengthening the Sacramento Weir 600 feet, and raising 12 miles of levee in the Yolo Bypass, building 2 miles of new levee, and strengthening 38 miles.

Environmental and Related Impacts and Mitigation. Less levee work would reduce impacts in the lower American River and in the Sacramento and Yolo Bypasses. Mitigation would include planting riparian and upland habitat along the lower American River and in the Yolo Bypass.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from about 1 chance in 100 to 1 chance in 200. Over 50 years, the chance of flooding would be reduced from about 39 percent to 22 percent. As with the other plans, modifications to the Sacramento River levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in 140 to 1 chance in 400.

The estimated first cost for this plan is about $533 million. The estimated net annual benefits amount to $22 million.

Folsom Stepped Release Plan.

General Description. This plan was formulated at the request of SAFCA to provide a relatively high level of protection to Sacramento while containing costs as much as possible. The plan is a modification of the Moderate Objective Release Plan with these principal changes: (1) a stepped release operation from an objective release of 145,000 cfs for more frequent floods to 180,000 cfs for rarer but larger floods, (2) no new river outlets in Folsom Dam, and (3) maintenance of the variable 400/670 reoperation at Folsom. The remaining features of this plan are similar to those of the previous "objective release" plans. Table IV-2 summarizes the major features of this plan.

Folsom Dam and Reservoir. Flood control storage space in Folsom would continue at a variable operation of 400,000 to 670,000 acre-feet, with the space required dependent upon the space available in the private reservoirs upstream from Folsom.

As with the other plans in this category, this plan includes increasing the outlet capacity of Folsom Dam by (1) lowering the spillway 15 feet, (2) enlarging the eight existing river outlets, (3) using the river outlets and spillway conjunctively during a major flood to reach the objective release, and (4) using surcharge storage. However, the plan does not include constructing new outlets below the auxiliary spillway. New outlets would be relatively ineffective with the other outlet modifications in improving the efficiency of the existing space because limitations on the release schedule required for downstream safety would not permit full use of the new outlet capacity prior to the water-surface elevation reaching the spillway crest. To help reduce costs, SAFCA requested that this measure not be included in the plan.

Lower American River. The objective release from Folsom would usually be 145,000 cfs, but under certain Folsom inflow and storage conditions would be raised to 180,000 cfs. Levee modifications along the lower American River would be designed to contain the 180,000-cfs release and would include construction of about 2 miles of new levee and 2 miles of new floodwall, raising 14 miles of levee, and modifying 26 miles. These levee modifications would raise the PNP at H Street to a stage of 51 feet and the PFP to 52 feet. Levee raising and placement of erosion protection would be done on the waterside of the levee, and slurry cutoff walls would be used to remedy levee seepage and stability problems. Also, three bridges would either be raised above the design water surface or modified to withstand inundation.

Interior drainage facilities (including sumps, pumping facilities, pipes, and other infrastructure) along the American River would be relocated or modified. However, these facilities, as well as downstream hydraulic mitigation features, would be designed to accommodate the lower objective release, 145,000 cfs. This objective release would allow control of the more frequent storms that would have overwhelmed the without-project flood control system. By the time the higher 180,000-cfs objective release would be required, the storms would be so large that the system would have failed. Additional protection could be provided to the areas along the lower American River without adversely affecting the reaches below the mouth of the American River more than they would have been under the without-project condition.

Downstream from American River. To ensure that the increased objective releases would flow into the Yolo Bypass (and not downstream along the Sacramento River), the Sacramento Weir would be lengthened and the Sacramento Bypass widened by 1,000 feet. These modifications would result in greater floodflows into the Yolo Bypass and a decrease in reliability of the Yolo Bypass levees. So to offset the impacts of these higher flood stages, the plan includes raising about 26 miles of levee in the bypass, strengthening 38 miles, constructing 2 miles of new levee, and modifying a Yolo Shoreline Railroad bridge over the Tule Canal.

Work on the east-bank levee of the Sacramento River at Natomas would be the same as the other plans.

Environmental and Related Impacts and Mitigation. The impacts and mitigation for this plan would be similar to impacts of the Maximum Objective Release Plan but less for the interior drainage facilities along the lower American River and for the hydraulic mitigation area.

The reoperation of Folsom at the variable 400/670 would be the same as the without-project condition, with those related minor impacts continuing. Work along the Sacramento River levee at Natomas and the impacts from it would be the same as with the other plans.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from 1 chance in about 100 to 1 chance in 235. Over 50 years, the chance of flooding would be reduced from about 39 percent to 19 percent. Modifications to the Sacramento River levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in about 140 to 1 chance in 400.

The estimated first cost for this plan is $539 million. The estimated net annual benefits are $24 million.

Increased Flood Protection With Minimum Impacts

The basic goal of this category is to increase the level of protection for Sacramento as much as possible through modifications to Folsom Dam and Reservoir and downstream flood control facilities with a minimum impact on the natural and socioeconomic resources of the study area.

Folsom Flood Storage Space Increase Plan.

General Description. The primary features of this plan are (1) increasing the flood control storage space in Folsom Reservoir to a variable space of 475,000 to 655,000 acre-feet, (2) use of surcharge storage, and (3) modifications to increase the outlet capacity at Folsom Dam, similar to the Maximum Objective Release Plan. No modifications would be required downstream along the American River. Modifications to the east-bank levee of the Sacramento River at Natomas would be the same as with the other plans. Table IV-2 summarizes the basic features of the plan.

Environmental and Related Impacts and Mitigation. This plan would have only minor construction impacts associated with work on the Folsom Dam outlets. The plan would have some effects on the delivery of local water supplies and on hydropower generation, and the increased flood storage space would result in an average annual net reduction of about 13,000 acre-feet in water deliveries of the CVP and SWP. Because the drawdown in Folsom Reservoir would occur during winter, there would be few recreation impacts. Impacts associated with the increased surcharge operation and outlet modifications would be similar to impacts with the Maximum Release Plan. Work along the Sacramento River levee at Natomas would have the same impacts as the other plans.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from 1 chance in 100 to 1 chance in 160. Over 50 years, the chance of flooding would be reduced from about 39 percent to about 27 percent. Modifications to the Sacramento River levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in 140 to 1 chance in about 400.

The estimated first cost for this plan is $296 million. The estimated net annual benefits are $28 million.

NED Plan

A major objective of the Federal plan formulation process is the identification of the NED (National Economic Development) plan. The NED plan is the plan that provides the greatest net benefits. This is the plan that would be recommended by the Federal Government unless an exemption was requested by the participating non-Federal sponsors for reasons of affordability or other suitable concerns.

From the initial array of alternative flood protection plans identified in this chapter, the plans providing new storage at Auburn appear to have the greatest potential for providing large net benefits. This was also the conclusion reached in the 1991 feasibility report, which identified as the NED plan an 894,000-acre-foot detention facility providing a 400-year level of flood protection. That plan, with a modified outlet configuration, is presented here to represent the NED concept. A plan to optimize NED benefits based on the without-project condition will be identified in the final Supplemental Information Report from the final array of candidate plans discussed in chapter V.

Feasibility Report NED Plan.

General Description. The major element of this plan is a flood detention dam upstream from Folsom Reservoir on the North Fork American River near Auburn. The dam would be constructed of roller-compacted concrete, be 508 feet high, and create a detention capacity of 894,000 acre-feet. Gates in each of 20 sluices (outlets) in the dam would be operated to reduce storage during fairly frequent floods and to retard the drawdown rate of the flood pool during large floods. Highway 49 would be relocated, and the Ponderosa Way bridge would be modified to withstand inundation. This plan would return the flood control storage space in Folsom Reservoir to the 1987 flood control operation of 400,000 acre-feet of seasonal storage. The additional storage would have a beneficial effect on downstream levee reliability, and no hydraulic mitigation features would be required. Modifications to the Sacramento River levee would optimize the level of protection in Natomas. The basic features of the Feasibility Report NED plan are summarized in table IV-2.

Environmental and Related Impacts and Mitigation. Impacts and mitigation for this plan would be similar to the 200-year plan previously described. The plan would

result in impacts in the American River canyon due to construction and operation of the detention dam.

Accomplishments and Costs. This plan would reduce the probability of flooding from levee failure in any given year from 1 chance in about 100 to 1 chance in 435. Over 50 years, the chance of flooding would be reduced from about 39 percent to about 11 percent. The plan would also result in increased benefits to the CVP and others from offsetting impacts associated with the without-project reoperation of Folsom Dam and Reservoir. Modifications to the Sacramento River levee at Natomas would reduce the probability of flooding from levee failure from 1 chance in 140 to 1 chance in 400.

The estimated first cost for this plan is $872 million. Net annual benefits are estimated at $45 million.

SUMMARY COMPARISON OF INITIAL ARRAY OF ALTERNATIVES

Included in table IV-2 is a comparison of the action alternatives for level of flood protection provided, basic physical features, estimated costs, and estimated benefits. Table IV-3 compares the alternatives to meet the four planning criteria established by Federal Principles and Guidelines. These criteria are (1) completeness, (2) effectiveness, (3) efficiency, and (4) acceptability, and are described below.

COMPLETENESS

Completeness is the extent to which an alternative plan provides necessary investments or other actions to ensure realization of the planning objectives. Following is a description of completeness with respect to seven important comparison factors: (1) objectives, (2) consistency, (3) further action, (4) physical implementability, (5) water-related resources, (6) environmental resources, and (7) hydraulic conditions. Overall, each of the alternative plans is complete. As table IV-3 shows, the detention dam plans and the Folsom Modification Plan tend to rate higher than the other alternatives, primarily because no significant future actions would be required to quantify and mitigate impacts associated with (1) changes to the CVP and SWP as a result of Folsom reoperation and (2) increased floodflows to the Sacramento River and Yolo Bypass.

Objectives

All the alternative plans address the planning objective of flood control. Plans that would increase the objective release from Folsom include features to also address recreation and environmental restoration needs within the basin. These plans include major levee and channel modifications along the lower American River and, so, have suitable project areas on which to accomplish the incidental goals. However, none of the alternatives address the need

TABLE IV-3

Summary Comparison of Flood Protection Alternatives to Meet Planning Criteria

Alternative	Plan Formulation Criteria				Relative Ranking
	Completeness	*Effectiveness*	*Efficiency*	*Acceptability*	
Feasibility Report Recommended Plan					
Equivalent Storage	Addresses one or more planning objectives. *Technically implementable with a high* probability of consistently providing the stated increase in protection without further actions. Improves existing water resources problems by eliminating need for reoperation and fully *mitigates for environmental damages*. No hydraulic mitigation required.	High level of flood protection. Does *not meet* incidental recreation or environmental enhancement goals. Improves water supply & hydropower capability of CVP by eliminating need for reoperation.	Very high net economic benefits. Large reduction in flood damages.	More than satisfies non-Federal flood control agencies' minimum flood control goal. Many interest groups expressed concerns about potential impacts in the American River canyon.	Very High
Relative Rank	Very High	High	Very High	High	
200-Year Storage	Same as the Equivalent Storage Plan.	Similar to Equivalent Storage Plan.	High net economic benefits.	Meets non-Federal flood control agencies' minimum flood control goal. Similar concerns as Equivalent Storage Plan.	High
Relative Rank	Very High	High	High	High	
High Level of Protection Without Flood Detention Dam					
Maximum Objective Release	Addresses one or more planning objectives but adversely affects water resources in CVP. Can consistently provide stated increase in flood protection and is technically implementable. Future actions may be required to reanalyze and fully compensate for impacts to water, power, and recreation at Folsom, as well as to environmental values in the American River. Requires hydraulic mitigation to compensate for impacts to other areas.	*Very high level of flood protection.* Positive contribution to recreation and environmental restoration. However, adversely affects water and power enhancement.	High net *economic benefits*, but includes uneconomical increments.	More than satisfies non-Federal flood control agencies' minimum flood control goal. However, little interest by non-Federal sponsors or other interest groups.	Moderate/ High
Relative Rank	High	Very High	Moderate	Low	
Moderate Objective Release	Similar to the Maximum Release Plan, but lesser impact on CVP resources.	High level of flood protection, *otherwise the same as the Maximum* Objective Release Plan.	Moderate net economic benefits. Includes uneconomical increments.	Same as Maximum Release Plan.	Moderate
Relative Rank	High	High	Moderate	Low	

TABLE IV-3 (cont.)

Summary Comparison of Flood Protection Alternatives to Meet Planning Criteria

Alternative	Plan Formulation Criteria				Relative Ranking
	Completeness	Effectiveness	Efficiency	Acceptability	
High Level of Protection Without Flood Detention Dam					
Minimum Objective Release	Similar to Maximum Objective Release Plan, but lesser impact on CVP resources.	High level of flood protection, otherwise the same as the Maximum Objective Release Plan.	High net economic benefits, but includes uneconomical increments.	Meets non-Federal flood control agencies' minimum flood control goal. Same lack of interest as Maximum Objective Release Plan.	Moderate
Relative Rank	High	High	Moderate	Low	
Folsom Stepped Release	Similar to Maximum Objective Release Plan, but does not increase adverse impact to CVP resources.	High level of flood protection, otherwise the same as the Maximum Objective Release Plan.	High net economic benefits, but includes uneconomical increments.	More than satisfies non-Federal flood control agencies' minimum flood control goal. Plan has been specifically formulated for non-Federal sponsor.	High
Relative Rank	Very High	High	Moderate	High	
Minimum Impact Plan					
Increase Folsom Flood Space	Similar to Minimum Objective Release Plan, but does not include features to address recreation and environmental restoration objectives.	Provides only a moderate increase in flood protection. Does not meet incidental recreation or environmental enhancement goals, and would have adverse impacts on water and power systems.	Very high net economic benefits. Moderate reduction in flood damages.	Does not meet non-Federal flood control agencies' minimum flood control goal. Little interest by non-Federal sponsors or other interest groups.	Moderate/High
Relative Rank	High	Moderate	Very High	Low	
NED Plan					
Feasibility Report NED	Same as the Equivalent Storage Plan.	Provides a very high level of flood protection. Otherwise the same as the Equivalent Storage Plan.	Very high net economic benefits. Very large reduction in flood damages.	Exceeds the non-Federal flood control agencies' minimum flood control goal. Similar concerns as the Equivalent Storage Plan.	Very High
Relative Rank	Very High	Very High	Very High	High	

for additional water supply in the basin or power production in the region. The detention dam plans and the Stepped Release Plan would eliminate, or not exacerbate, existing impacts on CVP operations from reoperation of Folsom's flood control space.

Consistency

This is the capability to consistently and reliably provide a specified degree of flood protection. Through R&U procedures, efforts were made to account for uncertainties in many parameters, such as inflow hydrology, reservoir operation, and downstream levee performance. Because of the large number of complex variables, it is simply not possible to completely account for all variables. Accordingly, it is likely that over time the stated level of flood protection may be found to be generally higher or lower. In any case, it is believed that each of the alternatives can be counted on to consistently provide the relative increases in flood protection levels that have been identified in this report.

Further Actions

Whichever plan is ultimately selected for implementation, it is expected that it will be constructed in total and over one time period. Accordingly, from a construction point of view, no further actions would be required other than normal operation and maintenance of project features to ensure fulfillment of the stated degree of flood protection and other project accomplishments. However, for those plans that include increasing the flood control storage space in Folsom Reservoir, there is a high uncertainty about the impacts to water supply, hydropower, recreation, and related reservoir resources. This uncertainty results from factors outside the control of the project operators, such as evolving standards for downstream water quality and operation of upstream reservoirs. Accordingly, the alternatives that include reoperation of Folsom Dam and Reservoir may require additional action over time to assess impacts and mitigation needs.

Physical Implementability

All the alternatives have a similarly high capability of being implemented. None present unusually difficult construction challenges.

Water-Related Resources

One factor in rating the completeness of a plan is in the ability to identify and mitigate unavoidable impacts to water, power, and recreation resources. As indicated, the certainty is fairly low to accurately identify and mitigate impacts to water, power, recreation, and related reservoir resources in Folsom Reservoir and in the CVP and SWP. Accordingly, those alternatives that include additional increases in the flood control storage space in Folsom are rated lower than those that do not.

Environmental Resources

The ability to mitigate unavoidable adverse environmental impacts is an important factor in completeness. The types of environmental impacts and scope of mitigation are fairly different for each alternative. However, the expected success is similar for all plans in the ability to accurately identify potential direct impacts and the potential ability of the mitigation measures to offset the direct impacts.

Hydraulic Conditions

This is the ability to identify and mitigate unavoidable adverse hydraulic impacts to other areas; that is, not to induce flooding or not to increase the risk of flood damages in adjacent areas. Plans that include increasing the objective release from Folsom Dam and modifying downstream levees (but without constructing new storage) would cause higher water stages along the Sacramento River, Yolo Bypass, and adjoining areas during certain major floods. The higher stages would tend to reduce the level of flood protection currently afforded by the downstream system of levees and related flood control facilities. Accordingly, features to mitigate for these potential hydraulic impacts were included in four of the plans. The downstream system is very complex. If the plan ultimately selected includes increasing the objective release from Folsom, then additional analyses will be needed to better define the extent of the hydraulic mitigation required and the likely environmental impacts.

EFFECTIVENESS

Effectiveness is the extent to which an alternative plan resolves the identified problems and achieves the planning objectives. Factors in measuring effectiveness include (1) flood protection, (2) recreation opportunities, (3) environmental restoration, and (4) water and power. Because of the significantly higher level of flood protection provided, the larger detention dam plans tend to rank higher than the other plans. The Maximum Objective Release Plan also ranks higher because of the high level of flood protection and contribution to recreation and environmental restoration goals.

Flood Protection

Figure IV-1 illustrates the level of flood protection expected for the alternative plans. As shown, the flood protection provided by the various alternatives would increase from 1 chance in 100 for the without-project condition to 1 chance in 435 of flooding for the highest level of protection (Feasibility Report NED Plan).

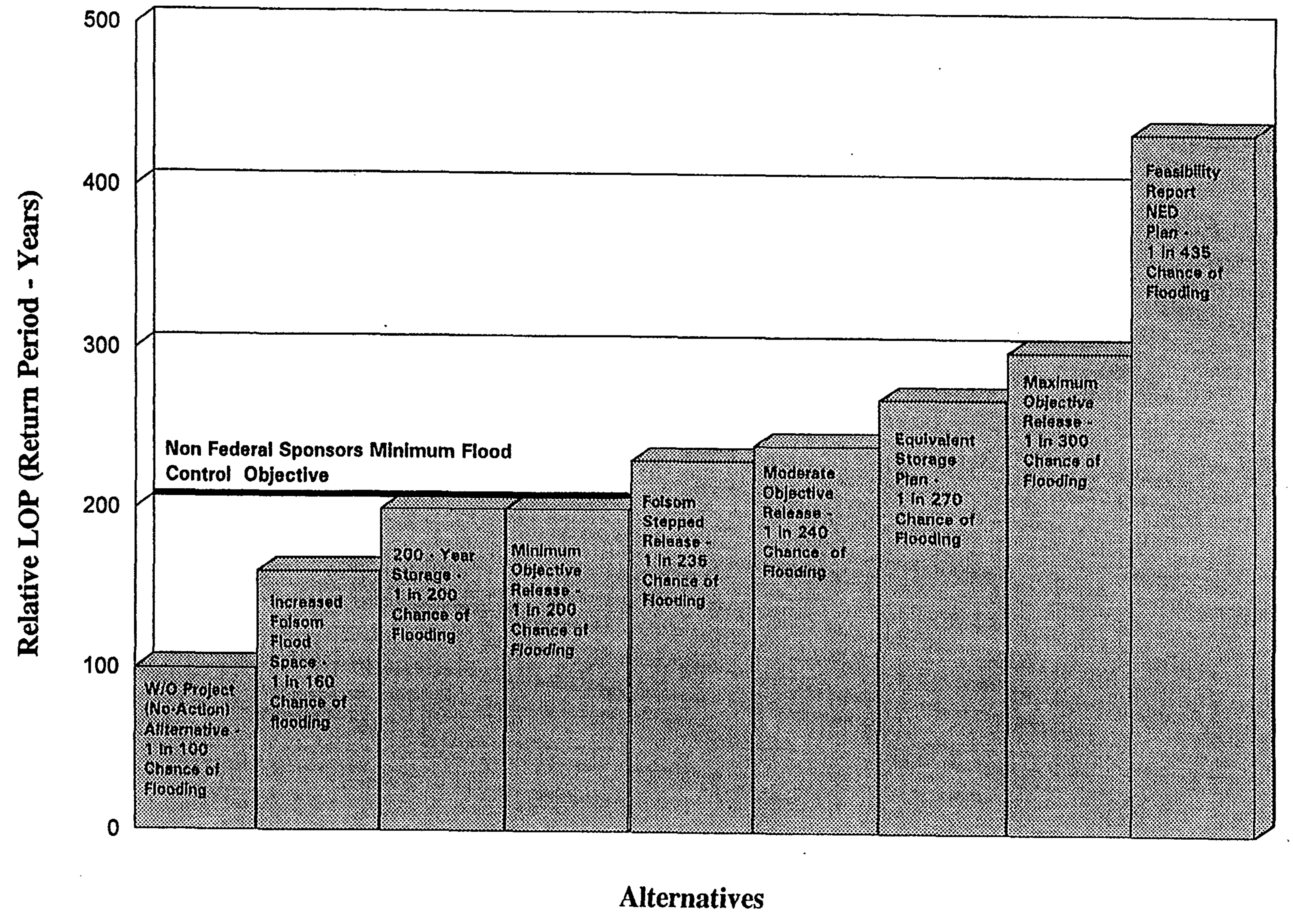


Figure IV-1. Relative level of protection (LOP) in years (estimated exceedence return period) for each of the nine initial alternatives. (A 200-year level of protection, for instance, has a 1 in 200 chance of flooding in any year.)

Because there is uncertainty about the flow and stage for a stated exceedence probability, the expected level of protection provided by an alternative is not a complete description of project performance. Plate 10 shows the effect that flood stage uncertainty for a given flood has on expected project performance for that flood. If there were "perfect knowledge" (for example, if floodflows and stages for given flood probabilities were exactly known), then plate 10 would simply reflect the estimated level of protection afforded by each alternative. For floods corresponding to exceedence probabilities greater than the protection level, the chance of protection would be zero, and for floods corresponding to exceedence probabilities less than the protection level, the chance of protection would be 100 percent. To reduce the uncertainty of containing a stated exceedence probability flood, an alternative providing a higher expected level of protection would be needed. Accordingly, given the estimated level of uncertainty on various parameters for each alternative, it can be seen from plate 10 that the chances of providing various levels of protection increases significantly for the alternative considered. As an example, there is approximately a 16 percent chance that the 200-year storm could be accommodated without levee failure under without-project conditions. This reliability increases to about 95 percent for the Feasibility Report NED Plan.

Recreation

Only those alternatives that involve significant structural work in the lower American River and downstream include the potential for adding recreation features in the American River basin.

Environmental Restoration

Only those alternatives that would require significant structural work in the lower American River and downstream include the potential for adding environmental restoration features in the American River basin.

Water and Power

None of the alternative plans address the need for increased water and power resources in the study area. However, alternatives including reoperation of Folsom Dam and Reservoir would adversely affect existing water and power resources. The detention dam plans would eliminate adverse impacts associated with the without-project condition reoperation.

EFFICIENCY

Efficiency is a measure of the extent to which an alternative is the most cost-effective means of alleviating the identified problems while realizing the specified objectives, consistent with protecting the Nation's environment. One measure of efficiency is monetary

costs versus benefits. Efficiency is displayed as net economic benefits and is the extent that the economic benefits exceed costs.

Net benefits for each of the alternatives are displayed in table IV-2. As shown, annual net flood control benefits (not including benefits during the construction period) range from a high of approximately $45 million for the Feasibility Report NED Plan to a low of about $19 million for the Moderate Objective Release Plan. It is important to note that even though each alternative produces net economic benefits, several major increments of the plans that increase the objective release are not economically feasible as a last-added increment. Appendix D, Plan Formulation, describes the incremental analysis process.

ACCEPTABILITY

Acceptability is the workability and viability of an alternative to other Federal agencies, affected State and local agencies, and public entities, given existing laws, regulations, and public policies. Support by a non-Federal sponsor is given considerable weight in this category. The relative acceptability of these alternatives was judged on the basis of review of the 1994 Alternatives Report by various Federal, State, and local interests in the fall of 1994 and spring of 1995. The final determination of the acceptability of the plans will be made following public review of the draft Supplemental Information Report in late summer 1995. At this time, however, because of the tentative support indicated by the potential non-Federal sponsors, the Stepped Release and Feasibility Report NED Plans were ranked highest for this criteria in table IV-3. There has been some additional feedback from these groups that plans including an increase in the level of reoperation may not be implementable.

Non-Federal Sponsor

Non-Federal participation in the project is essential because the non-Federal sponsor must share in the cost of construction and provide long-term maintenance and operation. Without this participation, it would not be possible to proceed with the project. The willingness and capability of the non-Federal sponsor to share the project cost is a major factor in determining a plan's acceptability.

A basic planning objective of the State of California and SAFCA is to achieve a high level of flood protection—greater than 200 years—for the people and property currently occupying the American River flood plain. This objective is based primarily on public safety considerations and the high residual risk of flooding associated with plans that provide less than a 200-year level of protection. The Reclamation Board and SAFCA recognize that the areas within the flood plain are subject to a significant risk of uncontrolled flows with the potential for a catastrophic loss of life and property.

Both the Reclamation Board and SAFCA held a series of joint public workshops and hearings on the various alternatives in December 1994 through February 1995. On the basis of those meetings, the two entities recommended in resolutions dated February 24, 1995, and March 10, 1995 (see appendix A), that two plans should be carried forward for detailed evaluation. The Reclamation Board and SAFCA intend to choose between the two plans for the locally recommended plan at the end of the comment period on this draft Supplemental Information Report.

Groups and Individuals

At the public meetings mentioned above, much testimony was received on flood protection for Sacramento. Testimony ranged from support for or opposition to one or more of the alternative plans to requests that the alternatives include other features such as water supply and additional recreation and environmental restoration. There were several well organized concerned groups that spoke out against a detention dam and in support of a plan improving the existing system. It was in part a response to this testimony that the Reclamation Board and SAFCA recommended proceeding with two candidate plans.

INITIAL FINDINGS

Table IV-3 includes an indication of the overall relative ranking of each of the initial array of alternative plans. The Stepped Release Plan and the detention dam plans were generally ranked higher than the other plans. The detention dam plans would significantly reduce flood damages, would alleviate the need for reoperating Folsom, and is tentatively supported by the non-Federal sponsors. Even though it has incrementally infeasible increments, the Stepped Release Plan would also provide a high level of protection and has strong non-Federal support.

CANDIDATE PLANS

Based on comments received on the Alternatives Report, comments at the public workshops and hearings, and results of continued studies, four alternatives were developed to represent the overall range of flood protection opportunities available for the Sacramento area. They are:

- No-Action Alternative
- Folsom Dam and Reservoir Modification Plan
- Folsom Stepped Release Plan
- Detention Dam Plan

OPTIMUM PLAN FEATURES

To aid in formulating specific sizes and combinations of measures in the candidate plans, several analyses were done to determine the most cost-effective mix of measures. This was particularly important for the plans that would provide increased protection without a detention dam.

Ten individual measures to increase Folsom storage, increase Folsom outlet capacity, or increase the downstream levee capacity were analyzed to determine the optimum combination for providing flood protection. (See Appendix D, Plan Formulation.) Two significant conclusions resulted from this analysis. First, to obtain at least a 200-year level of flood protection, alternatives would need to include increasing the objective release from Folsom Dam. Further, measures to increase the objective release from Folsom are not economically justified as a last-added increment. However, alternatives could be formulated that would include increased objective releases for which the total benefits of the alternatives would exceed the cost. Several of these alternatives are highlighted in appendix D.

The second result was that measures that increased Folsom's outlet capacity tended to result in a decrease in the reliability of the American River levees and the level of protection when added to other combinations of measures. This is because work that allowed the objective release to be achieved earlier would result in an increase in the probability of exceeding the PNP stage (the existing PNP is very close to the stage of the 115,000-cfs objective release). The uncertainty associated with the stage resulted in more frequent simulated levee failures and a lower level of protection. Adding a slurry wall would raise the PNP and thus improved the reliability of the existing levees. For almost all cases analyzed, this proved to be a cost-effective feature.

FOLSOM MODIFICATION PLAN

This specific plan was not in the initial array of alternatives. However, based on comments received, it was added as a candidate plan since it represents about the greatest level of flood protection available without increasing the objective release to the lower American River or new upstream storage. This plan was developed to define the optimized plan that would increase flood protection with minimum impacts. This plan is a modification of the Increase Folsom Flood Space Plan. The main goal of this plan is to achieve the highest level of flood protection for Sacramento with the least possible environmental and social impacts. This plan concentrates on limited modifications to existing facilities to provide a moderate increase in flood protection.

An incremental analysis was done to determine if all the individual measures were cost effective. Several changes were made to the mix of measures on the basis of results of the incremental analysis. First, the analysis showed that the four new outlets below the auxiliary spillway are not economically feasible as a last-added increment. The outlets are

justified in some instances, but when compared to other measures they are not as efficient in increasing flood protection. Therefore, they were dropped from the plan.

Second, the addition of a slurry wall in the existing levees was shown to be a feasible addition to the mix of components. Even though the initial concept of this plan was to concentrate on measures at Folsom Dam and to avoid impacts related to work along the lower American River, the impacts associated with the slurry wall would be very minor. Therefore, this increment fits well with the overall concept of the alternative.

On the basis of these changes, the range of reoperation increased from a variable 475,000 to 655,000 acre-feet to a range of 475,000 to 720,000 acre-feet.

FOLSOM STEPPED RELEASE PLAN

This alternative is similar to the plan presented in the initial array of alternatives. The plan was formulated at the request of the SAFCA to provide at least a 200-year level of flood protection to Sacramento while containing costs associated with a maximum increased objective release and no further increase in the variable flood space of 400,000 acre-feet to 670,000 acre-feet implemented as part of the without-project condition at Folsom. Based on analyses by SAFCA and Reclamation, SAFCA staff considered this to be a reoperation level acceptable to public-interest groups. This plan includes recreation and environmental enhancement features along the lower American River.

It is important to understand that other alternatives have been formulated providing in excess of a 200-year level of flood protection. Further, several of these alternatives would provide greater net economic benefits than the Stepped Release Plan. However, each would also require further increase in the seasonal flood control storage space in Folsom Reservoir. It was primarily because of the likely high resistance to the increased space that SAFCA requested development of this plan.

An incremental analysis demonstrated several things about the Stepped Release Plan. First, as indicated restricting the extent of reoperation reduced the net benefits. Except for increasing the lowering the spillway of Folsom and objective release, the remaining features of the plan were incrementally feasible. Adding levee improvements along the lower American River and hydraulic mitigation features to accommodate the higher objective releases increased flood damage reduction benefits, but at a greater incremental cost than the incremental benefits provided. The lowered spillway has other benefits in contribution to dam safety. However, the project overall would provide greater benefits than costs.

DETENTION DAM PLAN

The initial array of alternatives included three dam sizes. From the comparison of those alternatives, it was apparent that a flood detention dam could provide the greatest increase in the level of protection for Sacramento and could also provide the greatest net benefits. This supported the conclusion in the 1991 feasibility report of the 400-year dam plan as the NED plan.

Consistent with the request from the Reclamation Board and SAFCA, a reanalysis was made for this report to confirm the optimum capacity for a flood detention dam. Five dam sizes were analyzed using the risk-based analytical procedures to identify the size that would maximize net benefits. The net benefits are maximized at a detention capacity of about 894,000 acre-feet. This is comparable to the Feasibility Report NED plan. Therefore, the Feasibility Report NED Plan as revised for the initial array of alternatives reasonably maximizes the net benefits and is a candidate plan.

The levee optimization analysis showed inclusion of a slurry wall in the existing levees along the lower American River to be a cost-effective measure for most alternatives retaining the 115,000-cfs objective release. Adding approximately 24 miles of slurry wall to the existing levees on the lower American River is cost effective, significantly increases the level of protection to Sacramento, and does not change the dam size optimization.

The analyses of combinations of measures also indicated that there is potential to combine cost effectively some modifications to Folsom's outlet capacity and storage with detention storage at Auburn. A check of adding combinations of increased outlet capacity and increased variable storage showed that adding these features to the 894,000-acre-foot capacity was not cost effective.

CHAPTER V

CANDIDATE PLANS

GENERAL

The following sections describe the accomplishments, components, and design, construction, maintenance, and operation considerations for each of the four candidate plans: No-Action Alternative, Folsom Dam and Reservoir Modification Plan, Folsom Stepped Release Plan, and Detention Dam Plan. Included is a description of how each plan relates to the SAFCA Natomas project, reoperation of Folsom Dam and Reservoir, and other area flood protection projects, as well as a breakdown of the estimated costs and benefits of each plan.

NO-ACTION ALTERNATIVE

The No-Action Alternative is the same as the without-project condition which is described in chapter III. The plan describes the likely changes in the study area if no Federal flood protection project is implemented. No-Action serves as the baseline against which the impacts and benefits of the action plans are evaluated. Under the No-Action Alternative, the Federal Government would take no action to implement a specific plan to increase the level of flood protection to Sacramento. However, the following would be expected to occur (see chapter III for more detail):

- <u>SAFCA Local Project</u>. The Natomas levee construction authorized in the FY 93 DoD Act would be completed by SAFCA and the Natomas area would have at lease a 140-year level of flood protection.

- <u>Folsom Dam and Reservoir Reoperation</u>. The variable 400/670 reoperation of Folsom Dam and Reservoir initiated in March 1995 would continue indefinitely. This reoperation reduces the probability of flooding in Sacramento to about 1 chance in 100 and serves as partial mitigation for hydraulic impacts caused by SAFCA's local protection project in Natomas.

- <u>West Sacramento Project</u>. Construction of the West Sacramento Flood Control Project would be completed, providing a very high (approximately 400-year) level of protection to much of the area west of the Sacramento River and south of the Sacramento Weir and Bypass.

- **Folsom Dam Spillway Repairs**. Following replacement of the 1995 failed spillway date number 3 at Folsom and repair as required of the remaining spillway gates, the full capacity of the spillway will be restored.

- **Folsom Flood Management Plan**. Regardless of future actions in the watershed, Folsom flood management plan as directed by the FY 93 DoD Act will be implemented. The plan will result in an increase in the efficiency of the existing flood control system with improved monitoring of basin runoff, flood-warning systems, and structural modifications to the gates and outlets in Folsom Dam.

- **Folsom Dam Safety**. The ability of Folsom Reservoir to pass about 75 percent of the PMF will remain unchanged for the foreseeable future.

- **Sacramento River Bank Protection Project**. Bank protection work along the lower American River would be completed. It would include approximately 13,800 linear feet of erosion control construction primarily to prevent undermining of the flood control levees.

Urban development in the watershed will continue. Population trends, land use, and related urban growth along the main stem American River would continue generally as described in current local plans. Growing needs for additional water sources will significantly exceed available supplies.

Damages to real property from a flood caused by a storm even slightly greater than a 100-year or 400-year event would be in excess of about $7 billion or $16 billion, respectively. The average annual equivalent flood damages would be about $142 million. Other losses or adverse effects would include (1) loss of life (potentially), injuries during flood evacuation, and spread of waterborne infectious disease; (2) contamination from hazardous and toxic substances and, possibly, of ground water; and (3) losses of environmental resources required to rebuild flooded areas.

FOLSOM DAM AND RESERVOIR MODIFICATION PLAN

GENERAL DESCRIPTION

This plan includes (1) increasing the release capacity of the spillway and river outlets at Folsom Dam, (2) permanently increasing the flood storage space in Folsom Reservoir through both physical improvements and operational changes, (3) strengthening existing levees along the lower American River to improve their performance, and (4) raising and strengthening existing levees along the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River to optimize the level of flood protection in Natomas.

PLAN ACCOMPLISHMENTS

This plan would increase the level of flood protection to Sacramento by reducing the probability of flooding from the American River due to levee failure from 1 chance in 100 to 1 chance in 180 in any one year. It would reduce the chance of flooding in Natomas from 1 chance in 140 to 1 chance in 400 per year. Over a 50-year period, it would reduce the chance of flooding in Sacramento from without-project conditions from about 40 percent to 24 percent. (See plate 7.) It would provide nearly a 90 percent chance of protecting Sacramento during a 100-year storm, 54 percent chance for a 200-year storm, and 18 percent chance for a 400-year storm. (See plate 10.)

Primarily because this plan includes additional flood storage, it would reduce floodflows downstream from American River. It would increase the level of flood protection along the lower Sacramento river by about 50 percent and a slight reduction in the flood threat along the lower Yolo Bypass primarily for more frequent flood events.

The plan would reduce average annual equivalent flood damages about 43 percent. The plan includes features that would, in conjunction with existing policies and practices of local land use planning, offset adverse impacts on environmental resources directly attributable to construction and operation of the project. The plan would increase the ability of Folsom Dam to safely pass the PMF (probable maximum flood) without freeboard at Folsom Dam from about 75 percent to 90 percent.

RESIDUAL RISK

The residual flood risk to much of Sacramento would be moderate with this alternative. Residual flood damages would amount to about 56 percent of the without-project damages. There would be about a 45 percent chance that major flooding would occur along American River from a 200-year storm with this alternative. The residual flood threat to areas along lower Sacramento River would be about 50 percent of without-project conditions. In the Yolo Bypass, the residual flood threat would remain relatively high.

PLAN COMPONENTS

Folsom Dam and Reservoir

The Folsom Dam and Reservoir component of this plan would include the following work to improve the outlet efficiency and increase flood storage space.

Lower Main Spillway Crest 15 feet and Replace Main Gates. The five bays of the main spillway would be lowered 15 feet. (See figure V-1.) This would allow the objective release of 115,000 cfs to be reached earlier during a storm and help maintain storage space in Folsom Reservoir to absorb large inflows. The existing service gates would be replaced with similar type gates, but 18 feet taller. The taller gates are necessary to allow larger surcharge storage space to be used without overtopping a closed gate.

Extend Stilling Basin. The main-spillway stilling basin would be extended 50 feet downstream to accommodate the increased force of flood releases created by the higher hydraulic head above the spillway crest during large floods.

Enlarge Eight Existing River Outlets. The eight existing river outlets would be enlarged to 6 feet wide and 12 feet high. This would increase the reservoir release capacity while the water surface is still below the spillway crest.

Modify Surcharge Storage Operation. This includes (1) raising the impervious cores of Mormon Island Dam and Dikes 5 and 7 to increase the usable storage space in Folsom Reservoir above the flood control pool (see figures V-2 and V-3) and (2) modifying the operation of the reservoir to reflect this normalized use of the surcharge space. By modifying the spillway gates and embankments, the water surface could be allowed to rise higher in the reservoir before requiring emergency spillway releases. Plate 11 is the revised emergency-spillway release diagram. This creates an additional 40,000 acre-feet of storage.

Replace Three Emergency Gates. The emergency-spillway gates would be replaced with similar type gates, but 6 feet taller. The taller gates are necessary to control the increased surcharge operation. The higher reservoir water surface reached during the increased surcharge operation could overtop the gates if they were not enlarged.

Increase Flood Control Storage Space. This consists of increasing the seasonal flood control storage space in Folsom from a variable space of 400,000/670,000 acre-feet to 475,000/720,000 acre-feet. Figure V-4 shows an abbreviated flood control diagram for this operation. More often than not, the minimum vacant space required in Folsom Reservoir during the flood season would be 475,000 acre-feet. However, in some years, or for variable durations during some years, the space would need to be increased to as much as 720,000 acre-feet depending on available creditable space in upstream reservoirs.

Telemeter Upstream Inflow Gages and Emergency Flood-Warning System. This work includes construction or modification of telemetered gaging stations upstream from Folsom Reservoir on the three main forks of the American River and implementation of operation changes to use data from the gages to enhance the real-time operation of Folsom during a storm. An improved automated flood-warning system along the lower American River is included to facilitate emergency evacuation of the floodway. (See plate 12.)

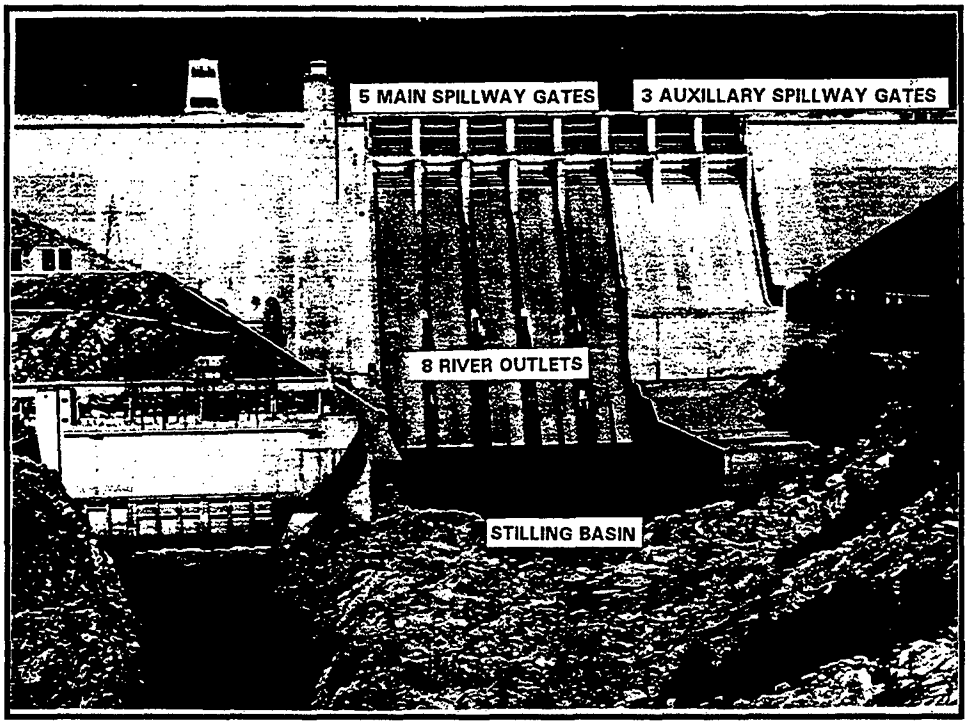


Figure V-1. Photo showing locations of major structural modifications at Folsom Dam.

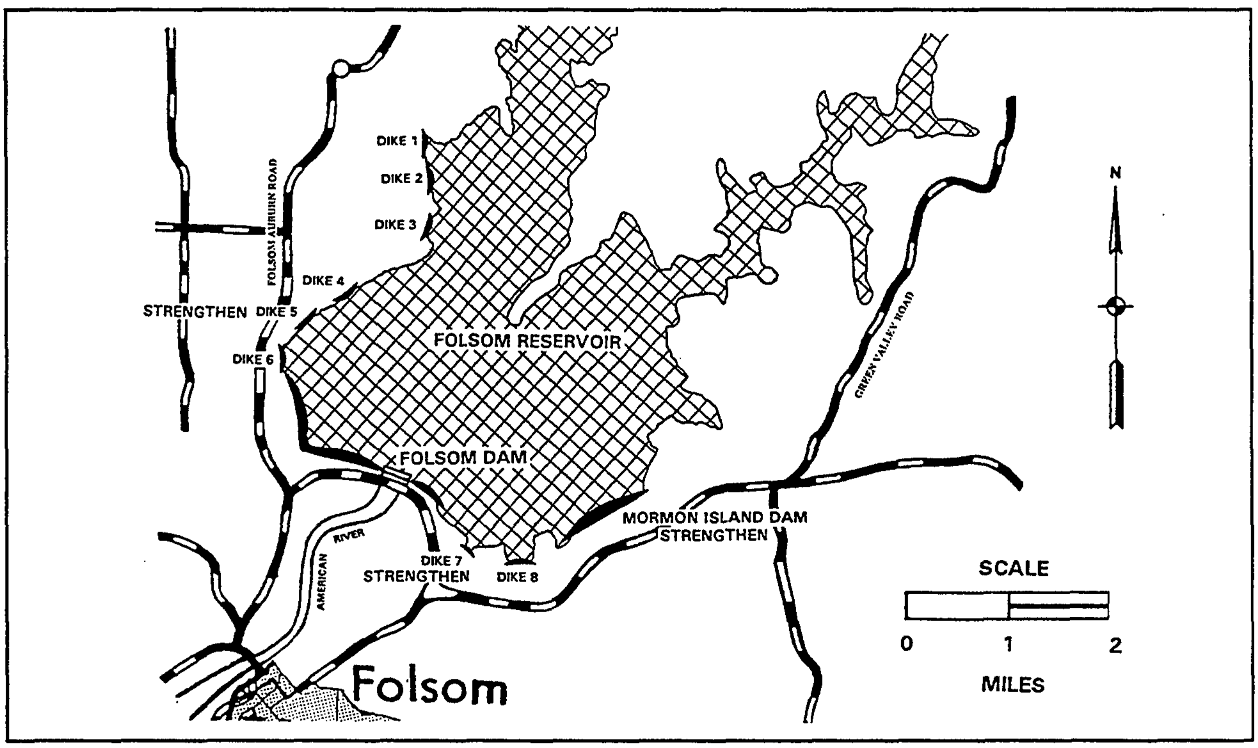


Figure V-2. Plan view of Folsom Dam and Reservoir showing location of dam-core raising.

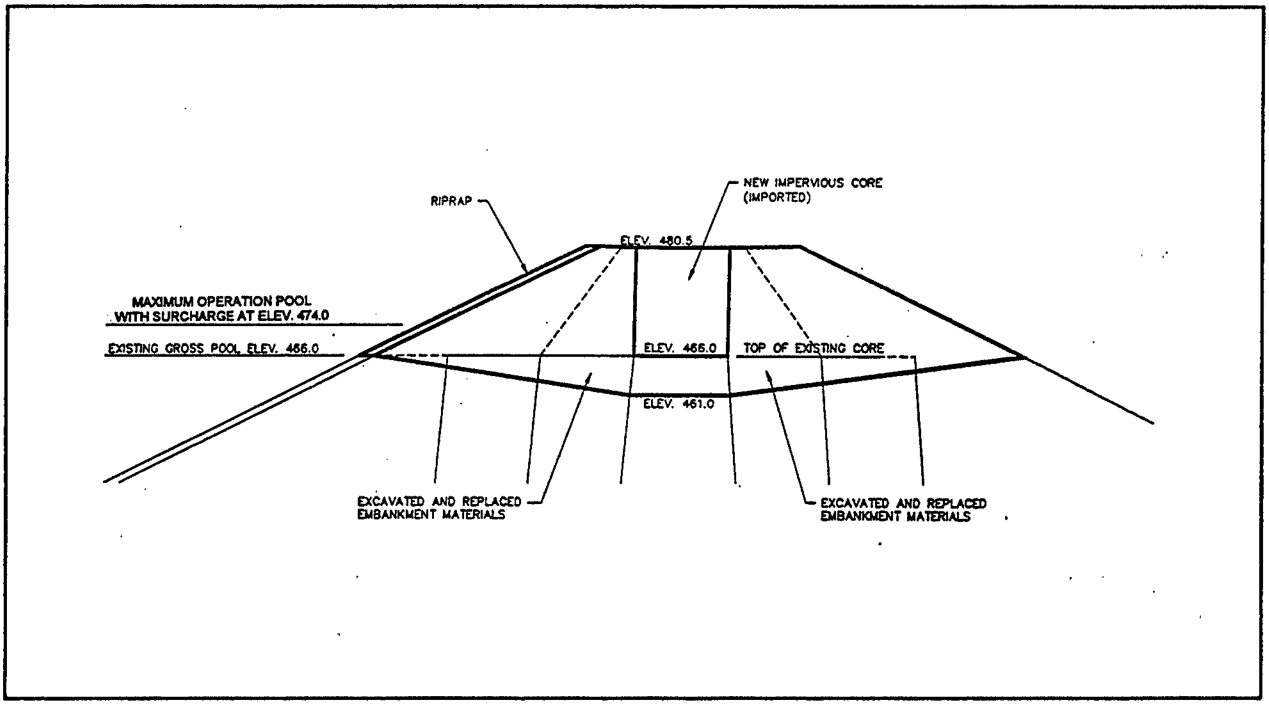


Figure V-3. Cross section view showing typical dam-core raising.

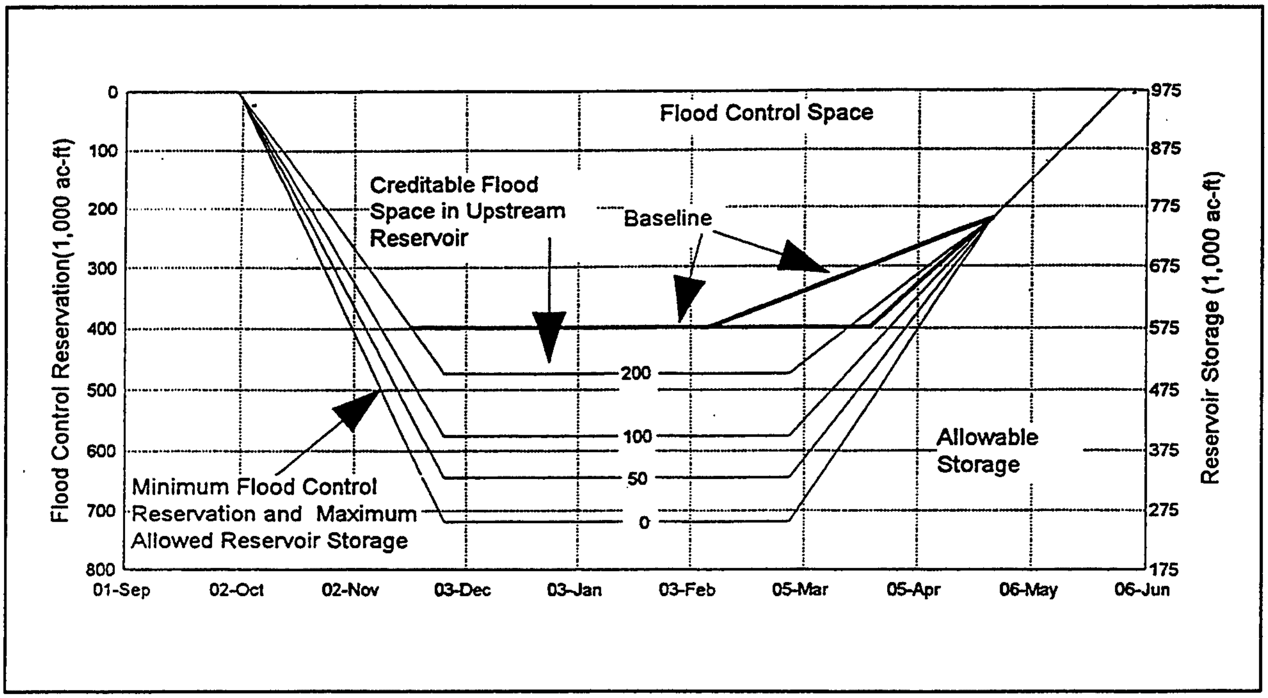


Figure V-4. Flood control diagram for Folsom Dam and Reservoir Modification Plan.

Lower American River

Improvements to the flood control system along the lower American River would consist of constructing approximately 24 miles of slurry wall in the center of the existing levees. (See figure V-5 and plate 13.) The slurry wall would reduce the chance of seepage through the existing levees under all flow conditions and would allow the levee foundations to better withstand hydraulic forces during higher water stages. The objective release from Folsom Dam to the lower American River would remain at 115,000 cfs.

Downstream from American River

The slurry wall would improve the operation of the exiting levees under the current 115,000-cfs objective release, but it would not substantially reduce levee failure at higher flows. Therefore, this plan would not substantially increase the volume of water flowing past the mouth of the American River and thus not adversely affect the flood control system downstream. As a result, hydraulic mitigation features are not required.

Natomas

The Natomas levee improvements and related features constructed by SAFCA would be compatible with the features and operation of the Folsom Modification Plan. Costs for the SAFCA Natomas project would be incorporated into this project through a crediting agreement. This plan would include additional levee construction, including stabilizing and

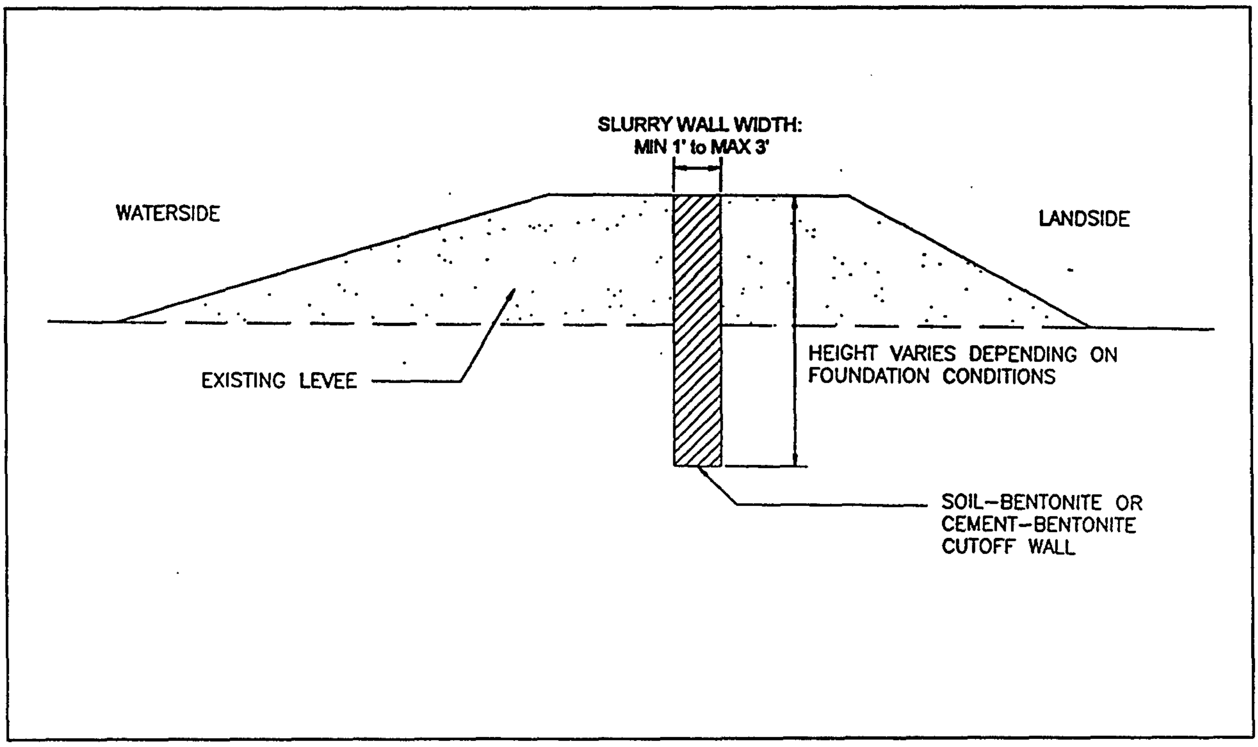


Figure V-5. Cross section view showing typical slurry wall construction.

raising portions of about 12 miles of existing levees along the east bank of the Sacramento River downstream from the Natomas Cross Canal. This work will increase the flood protection provided from the Sacramento River along the west side of Natomas area to a high level comparable with the rest of the levee reaches in Natomas. Included in figures V-6 and V-7 are drawings of typical levee raising and levee seepage and stability work to be accomplished as part of this plan. Plate 14 shows the general location of the work.

DESIGN AND CONSTRUCTION CONSIDERATIONS

Folsom Dam and Reservoir

Low-Level Outlet Capacity and Reservoir Storage. The physical constraints of the existing outlet works and spillways of Folsom Dam limit the effectiveness of the flood space in Folsom Lake. This is due mainly to the inability of making large flood releases when the lake level is below the spillway crest. Therefore, the major design considerations at Folsom are to improve Folsom Dam's ability to make large flood releases earlier in the flood and to more efficiently utilize reservoir space in Folsom Lake for flood control. The design features to improve the flood control release capacity at low elevations in the flood space include lowering the main spillway and enlarging the eight existing river outlets. The efficiency of the additional surcharge storage space obtained by modifying the spillway gates and embankments and by increasing reoperation is increased when combined with enlarging the outlet capacity.

Minimize Impacts to Traffic Flow, Recreation, and Environment. Folsom Dam Road is a major traffic artery across the American River. The construction work at Folsom would be designed and scheduled to allow public traffic to continue to use the road with minimum interruptions, especially during peak commuter traffic times. A floating cofferdam or upstream bulkhead would be installed to allow pool levels to be maintained.

Folsom Lake is a major recreation destination for northern California. In addition, the reservoir provides significant benefits to wildlife and vegetation resources in the reservoir area, along the lower American River, and downstream to the Sacramento-San Joaquin Delta. Modifications to Folsom's outlets would be constructed in such a way that the reservoir would not have to be drawn down to complete the work. Normal operation of the dam and reservoir could be maintained, thus avoiding significant adverse impacts to recreation and environmental resources.

Lower American River

Levees along the lower American River are stable as designed for flows of 115,000 cfs at river stages under today's channel and vegetation conditions in the lower American River. There is some uncertainty about the effectiveness of future maintenance of floodway vegetation and physical channel changes that could increase river stages for the objective

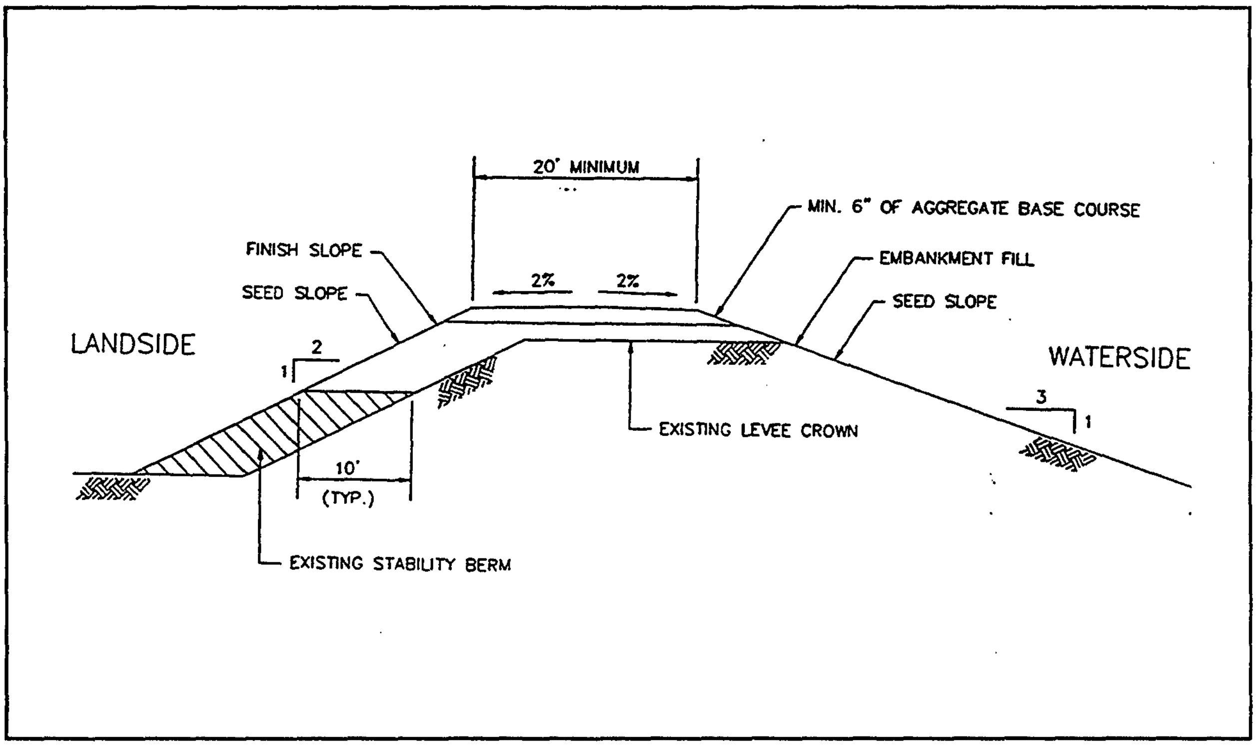


Figure V-6. Cross section view showing typical levee raise.

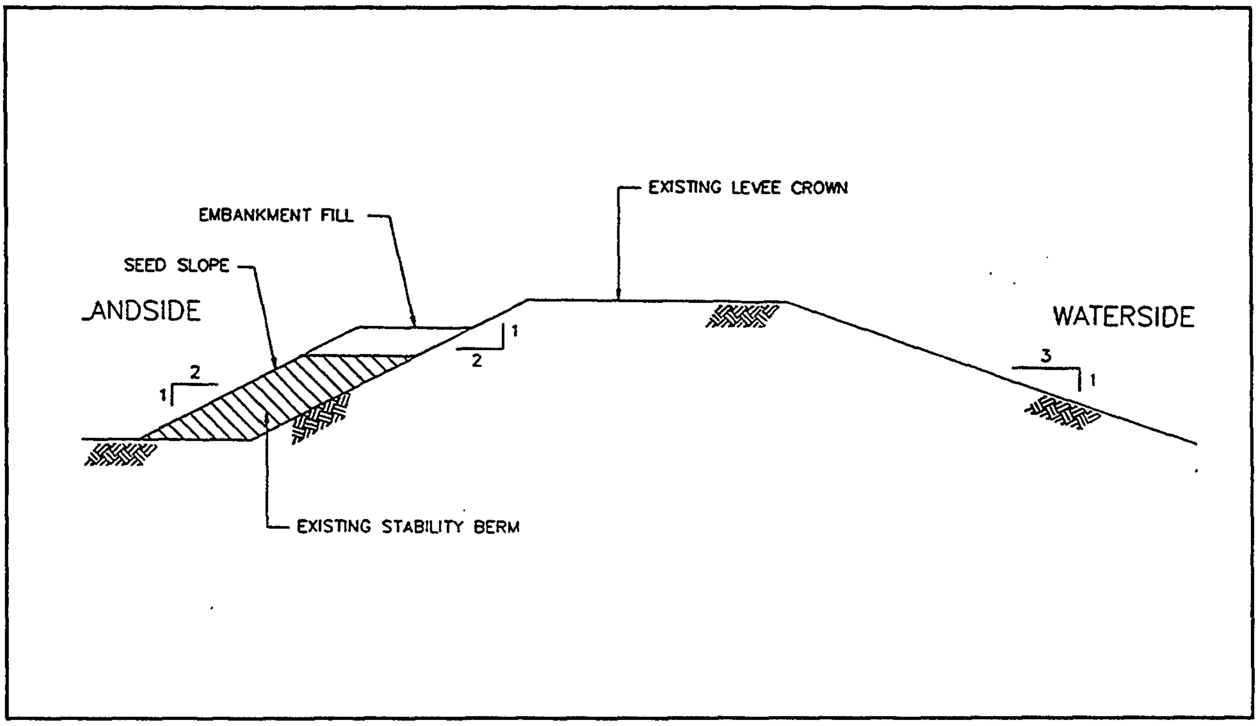


Figure V-7. Cross section view showing typical levee stability berm raise.

release and cause slope stability problems along the landside of the American River levees. Any conditions that increase river stages, even for relatively short flood durations, may increase the likelihood of foundation seepage and piping. To reduce levee seepage potential and provide increased levee stability, the existing levees would be strengthened with a vertical slurry cutoff wall. The slurry wall design was selected because of the limited space on the landside of the existing lower American River levees and the potential for adversely affecting vegetation and aquatic resources on the waterside of the levee. The work would raise the PNP a minimum of 2 feet along the existing levees.

Natomas

SAFCA is constructing a local project in Natomas. Additional work in Natomas included in the American River Watershed Project is on the east bank of the Sacramento River between the Natomas Cross Canal and the American River. This levee reach has the lowest level of reliability and controls the level of protection in Natomas. The cost effectiveness of raising this reach and other areas as necessary to optimize flood protection in Natomas was analyzed. Raising the PNP in this reach 2 feet would increase the protection comparable with the SAFCA project.

ENVIRONMENTAL IMPACTS AND MITIGATION

Direct Construction Impacts

Folsom. The construction of the outlet improvements at Folsom would have some temporary impacts on air quality, local traffic, and noise levels. These impacts would be mitigated by using best management and construction practices during the construction period. This plan avoids changing the operation of Folsom Reservoir for construction of the outlet modifications; therefore, no short-term operation impacts would result.

Lower American River and Natomas. Construction of the slurry wall would be from the top of the existing levee, and existing access routes would be used. Therefore, impacts to fish, wildlife, and related resources would not be significant. Noise, local traffic, and air quality impacts would be temporary and would be mitigated through use of best management and construction practices.

Work along the Sacramento River in Natomas would be accomplished either from the levee crown or on top of an existing stability berm. Habitat losses would consist of grasses on the levees and berms and would be replaced by reseeding all construction areas after completion of the work. The principal impacts associated with the Sacramento River levee work would be temporary disruption to local traffic to raise portions of the Garden Highway.

Operation Impacts

Modifications to Folsom's outlet capacity and surcharge storage would affect flood control operations. Changes in the releases to the lower American River and water-surface elevations in Folsom Reservoir would occur only during floods that are relatively infrequent and of short durations; therefore, these changes would have little effect on the habitats of the lower river.

Principal operational impacts would result from increasing the seasonal flood storage space to 475,000/720,000 acre-feet. The increase would have some adverse impacts on water supply and power production. The economic value of these losses was based on replacement as needed through water rights purchases or purchase of additional power from existing power sources. However, should this alternative be selected, a monitoring program would be developed to (1) periodically assess potential changes to the identified impacts that may result from new CVP/SWP operating criteria and (2) determine if more appropriate mitigation methodologies are required.

Operation studies indicate that increasing flood storage in Folsom above the current reoperation level would not result in additional adverse impacts on environmental resources. Mitigation features implemented by SAFCA and Reclamation would continue to compensate for the impacts of the initial 400/670 reoperation increment.

OPERATION AND MAINTENANCE CONSIDERATIONS

When a project is completed, ownership normally is transferred to the non-Federal sponsor, who is then responsible for the operation, maintenance, replacement, and rehabilitation of the project. However, the Folsom Modification Plan involves improvements to existing facilities owned by the Federal Government and State of California. No transfer of ownership would occur as a result of the modifications, but the non-Federal sponsor would be responsible for the increased maintenance costs of the existing structures.

Operation

The operation of the Folsom Modification Plan would be similar to the without-project condition (No-Action Alternative). The Corps would revise the water control manual for Folsom Dam to reflect the new flood control diagram and emergency-spillway release diagram. Reclamation, in coordination with the State Flood Operations Center, would continue to operate Folsom Dam in accordance with the operation manual. No increased operating costs are anticipated at Folsom to meet flood control requirements.

The lower American River and downstream components would be operated by the districts and agencies that currently operate and maintain the floodway and levees. During floods, the levees and floodwalls would be patrolled continuously to locate possible boils or unusual wetness that signals a problem in the structure. Appropriate advance measures

would be taken to ensure the availability of adequate labor and materials to meet all contingencies. Immediate steps would be taken to control any condition that would endanger the levee and to repair the damaged section.

Maintenance

The periodic maintenance of the project would be described in an O&M manual prepared by the Corps. Operation and maintenance costs of the new spillway gates and river outlets would be the responsibility of the sponsor. However, since Folsom Dam is owned by the Federal Government, the O&M would continue to be performed by Reclamation, but a cost-sharing agreement would be negotiated with the sponsor to pay that portion of the O&M costs related to the flood control features. Maintenance of the telemetered streamflow gages and the Sunrise Boulevard portion of the automated emergency warning system would also become the responsibility of the sponsor.

Maintenance of project features in the lower American River and Natomas would be similar to the existing system and would consist of (1) inspecting and maintaining levees regularly and keeping them free of growth that could reduce reliability and (2) operating and maintaining pump stations, gates, and detention basins as recommended.

A postconstruction inspection plan would be detailed in the O&M manual. At Folsom, Reclamation would inspect completed works. Along other areas of the project, the local sponsor would perform the inspections and prepare semiannual reports similar to existing report requirements on the levee system. The Corps could participate in this inspection and would review the reports. The Corps would continue its responsibility to ensure that the local sponsor inspects, operates, maintains, and rehabilitates the project facilities according to the criteria provided in these manuals.

RELATIONSHIP TO OTHER AREA FLOOD CONTROL FACILITIES

Folsom Spillway Adequacy

Folsom Dam can pass about 70 to 75 percent of the PMF without overtopping the structure. The lower figure is based on 5 feet of freeboard, while the higher figure assumes no freeboard. With the Folsom Modification Plan, Folsom Dam could pass about 75 percent of the PMF with 5 feet of freeboard and 90 percent with no freeboard. In either case, releases to the lower American River would exceed the capacity of the levee system.

SAFCA/Reclamation Reoperation of Folsom Dam and Reservoir

As part of this plan, the interim reoperation flood control diagram would be replaced with a revised flood control diagram for the larger variable space. Costs associated with the impacts of the full range of the 475,000/720,000-acre-foot operation are discussed in the cost-sharing analysis in chapter VII.

West Sacramento Project

The West Sacramento Project, scheduled for construction in 1996, would be slightly enhanced by this plan. Because of the additional flood storage in Folsom, flood releases for a given frequency of storm would be reduced. This would have a beneficial impact on the West Sacramento Project for rare flood events.

Sacramento River Bank Protection Project

This ongoing project addresses bank erosion issues on the Sacramento and American Rivers. Since bank erosion occurs independently of the objective release, implementation of this plan would not likely affect that project or current rates of riverbank erosion.

Sacramento and American Rivers Flood Control Projects

The Sacramento River Flood Control Project includes a system of levees and bypasses that extends from Chico to the Delta. Portions of this system in the vicinity of Sacramento would be slightly improved by this plan. By controlling flows on the American to 115,000 cfs for a longer period of time, the lower Sacramento River and Yolo Bypass levees would be more reliable than under the without-project condition. The American River Flood Control Project levees would be improved with the slurry wall and would continue to be operated for a maximum safe flow of 115,000.

Natomas Levee Construction Project

The work along the east levee of the Sacramento River would complement SAFCA's Natomas project and provide a the level of protection to the Natomas basin consistent with the local work..

Central Valley Project

This plan would reduce the net yield of the CVP by about 13,000 acre-feet per year on average (out of a total yield of 7 million acre-feet) and reduce the power generation and capacity. The Folsom Modification Plan includes mitigation for these losses and incorporates existing mitigation features constructed under the current Folsom reoperation for impacts to natural, cultural, and recreation resources.

PLAN ECONOMICS

Estimates of costs and benefits for this plan are based on October 1995 price levels, a 7⅝ percent interest rate, and a 100-year period of analysis. Construction would begin in the year 2000 and be completed in 2007.

A significant cost feature in this alternative is the additional flood storage space required in Folsom Reservoir. This increase in space would result in reductions in CVP and SWP water supply and power production. It would also adversely affect recreation and some cultural resources in Folsom Reservoir. Table V-1 summarizes the impacts, mitigation options, and mitigation costs. These economic values are included in this plan to help describe the full project cost for (1) plan comparison and (2) cost allocation. Although many of the costs are an annual replacement cost, they have been are included in table V-2 as a present-worth first cost.

Should this plan be selected, continued operation of this project element would be the responsibility of Reclamation and the non-Federal sponsor. It is expected that the costs for water and power replacement in table V-1 would be periodically negotiated over the life of the project between the sponsors, Reclamation, and Folsom area water purveyors. These periodic costs are expected to be significantly less than shown in the table in the early years of the project and likely significantly exceed the costs in the latter years.

TABLE V-1

Folsom Modification Plan - Incremental Impact and Cost of Reoperation
(400,000/670,000 acre-feet to 475/720,000 acre-feet)

Item	Impact	Mitigation	Cost ($1,000)
CVP-SWP water supply reduction (acre-feet per year)	13,000 [1]	Replacement supply	7,200 [2]
Power reduction Energy (GWh/year) Capacity (MW/month)	 6 12	Replace power by purchase from WAPA	1,300 [2]
Local water supply pumping (GWh/year)	1	Same as above	30 [2]
Folsom recreation (visitor day reduction)	6,900	Extend low-water boat-launching ramps	400 [3]
Folsom cultural resources (Sites potentially affected)	143	Inventory and recovery program	200 [3]

[1] Difference between average annual reductions in dry periods of 35,000 acre-feet and average annual increases primarily in wet periods of 22,000 acre-feet.

[2] Annual cost.

[3] First cost.

Costs

The estimated first and annual costs of the Folsom Modification Plan are summarized in table V-2. The total first cost is about $399 million, and the average annual cost is about $44 million. Additional information on costs is contained in Appendix E, Designs and Cost Estimates.

TABLE V-2

Folsom Modification Plan - Cost Estimate [1]
($ million)

Item	Total Previously Expended Thru FY 96	Folsom Dam & Reservoir	Lower American River [2]	Natomas Area	Total
First Cost					
Lands and management		0.0	2.0	1.5	3.5
Roads and relocations		0.1	0.0	0.0	0.1
Dam		109.1	0.0	0.0	109.1
Levee modifications		0.0	31.2	9.3	40.5
Cultural resources		1.3	0.3	0.1	1.7
Resources replacement		190.9	0.0	0.0	190.9
E, D, S, and A	15.0	26.0	10.5	2.1	53.6
Total	15.0	327.4	43.9	13.0	399.4
Investment Cost					
First cost	15.0	327.4	43.9	13.0	399.4
Interest during construction	19.9	111.9	29.3	11.2	172.3
Total	34.9	439.3	73.3	24.2	571.7
Annual Cost					
Interest and amortization	2.7	33.5	5.6	1.8	43.6
Operation and maintenance	0.0	0.2	0.0	0.0	0.2
Total	2.7	33.7	5.6	1.8	43.8

[1] October 1995 price levels, 100-year economic project life, and 7⅝ percent interest rate.
[2] Includes flood warning system.

Benefits

As shown in table V-3, the total average annual benefits for flood control are about $99 million (including future growth in the flood plain over the project life). This primarily includes flood damage reduction benefits over the project life ($68.7 million) and flood

control benefits during the construction period prior to the base year of 2008. Additional information on the benefit analysis is in Appendix C, Economics.

TABLE V-3

Economic Summary of Folsom Modification Plan

Item	($ million)
First cost	399.4
Annual costs [1,2]	43.8
Annual benefits [2,3]	
Flood damage reduction	68.7
Benefits prior to base year [4]	29.5
Total	98.2
Net annual benefits	54.4
Benefit-to-cost ratio	2.2

[1] Includes IDC and a base year (project year 1) of 2008.
[2] 100-year economic project life and 7⅝ percent interest rate.
[3] Inundation reduction benefits including future growth through project life and traffic disruption.
[4] Economic average annual value of benefits during construction.

Economic Justification

Overall Feasibility. As table V-3 shows, the estimated net annual benefits of the Folsom Modification Plan are about $54 million and the benefit-cost ratio is 2.2 to 1.

Incremental Analysis. Federal planning policy requires that physically separable elements of a project be economically feasible in order to receive Federal contributions toward their cost. It also requires that major project features be feasible as a last-added increment. All the various pieces of this plan—telemetered gages, enlargement of the outlet works (existing river outlets and spillway), increased storage from reoperation and surcharge space, a slurry wall in levees on the lower American River, and improvements to levees in Natomas—were all found to be cost-effective increments.

For this plan, the levee stabilization work along the lower American River and the Natomas levee improvements can each be considered as a separable last-added increment to modification of Folsom Dam and Reservoir. They are separable project elements because

they are not dependent on other features to provide benefits. The share of the first cost of this plan creditable to the lower American River is $44 million and the share to Natomas is $13 million. The resulting average annual costs are $5.6 million and $1.7 million. The average annual flood control benefits are $5.6 million and $23.1 million, respectively. Since the benefits outweigh the costs, the features are economically feasible as a last-added increment. All elements of this plan are incrementally feasible.

IMPLEMENTATION

Features and Costs

Successful implementation of this alternative would include constructing the above mentioned physical features and replacement, or mitigation, of water related resources adversely impacted due to increasing the flood control space at Folsom. As highlighted in table V-1, these resources primarily include water supply, hydropower production, local water delivery capabilities, recreation, and reservoir area cultural resources. Mitigation of the resources forgone would need to consider two elements. First, the increased space requirements for this plan from the without-project condition (variable space increase from 400,000/670,000 acre-feet to variable space from 475,000/720,000 acre-feet). Table V-1 highlights the resource replacement mitigation features and their economic costs. Secondly, however, implementation needs to include resolution of the resources forgone due to permanently increasing the flood control storage space from the 400,000 acre-feet fixed space (without-project condition). These incremental elements are described in chapter VII.

Estimated costs to implement this alternative has a high degree of uncertainty. This is primarily because of variabilities in the magnitude of impacts caused be reoperating Folsom Dam and Reservoir for increased flood control and the methods and resulting costs to mitigate these impacts. The estimated first cost for this alternative is about $399 million. Estimated costs less costs to replace resources forgone due to reoperation (see table V-2) amounts to about $209 million. Using currently estimated resource impacts and replacement costs, the additional implementation costs could amount to nearly $240 million. This includes (1) $191 million in excess of the without-project condition (see table V-2) and (2) $69 million for the increment of the plan resulting in the permanent reoperation of Folsom Dam and Reservoir.

Of the impact categories shown in table V-1 and explained in chapter VII, the estimated reduction in CVP/SWP water supply and resulting mitigation costs has the highest uncertainty. For instance, a unit value of $300 per acre-foot for reduced water supply was estimated to assess the relative economic cost for this alternative. This is the estimated unit costs to develop a replacement source of water supply. However, as mentioned in chapter VII, other mitigation features not including replacing the forgone water could be considered. Some, depending on market conditions at the time of implementation, could be less costly.

To indicate a lower range in costs for this alternative, included in table V-4 is an estimate of the total costs under several conditions. One is with and without water supply replacement and the other is with and without inclusion (Federalizing) the initial increment of reoperation. As noted, costs can range from about $399 million to $240 million, depending on whether or not the costs of water supply replacement is included or not. On the other hand, the costs could be as great as $469 million should permanent reoperation be included in the plan.

Cost Sharing

Also included in table V-4 is an estimate of the range in cost sharing between the Federal Government and the non-Federal sponsor, should this plan be selected for implementation. Whether or not permanent Folsom reoperation is included in the implemented plan, the likely non-Federal share of the total costs (1995 price levels) would range from $399 million to about $469 million. A potential—although highly unlikely—lower limit in the non-Federal costs could range from about $246 to about $276 million.

TABLE V-4

Folsom Modification Plan - Cost Allocation [1]
($ million)

Item	Full Resources Replacement			Without Water Replacement		
	Federal	**Non-Federal**	**Total**	**Federal**	**Non-Federal**	**Total**
First Cost						
Without resources replacement	204.5	4.0	208.5	204.5	4.0	208.5
Cash adjustment	-48.1	48.1		-48.1	48.1	
Resources replacement [2]	143.2	47.7	190.9	23.7	7.7	31.4
Total	299.6	99.8	399.4	180.1	59.8	239.9
Percent of First Cost	75	25		75	25	
With Federalization of Folsom Reoperation						
Permanent reoperation [3]	76.3	25.4	101.7	19.1	6.4	25.5
Total	375.9	125.2	501.1	199.2	66.2	265.4
Percent of First Cost	75	25		75	25	

[1] 1995 price levels.
[2] Resources replacement costs allocated 75 percent Federal and 25 percent non-Federal.
[3] Permanent Folsom reoperation allocated 75 percent Federal and 25 percent non-Federal.

FOLSOM STEPPED RELEASE PLAN

GENERAL DESCRIPTION

In this plan, the spillway, dam embankments, and outlet works of Folsom Dam and the flood control operation would be modified as in the Folsom Modification Plan. However, the current flexible operation of 400,000/670,000 acre-feet would not be increased. The levees along the lower American River would be modified for an objective release of 180,000 cfs. Flood releases from Folsom would be "stepped" from 145,000 cfs to 180,000 cfs, depending on the severity of the storm and its effect on Folsom inflows and storage.

Downstream from the American River, improvements such as lengthening the Sacramento Weir, widening the Sacramento Bypass, and constructing levee improvements in the Yolo Bypass would be made to handle the increased flows. The east levee of the Sacramento River between the Natomas Cross Canal and the mouth of the American River would be modified to increase flood protection for Natomas. The plan includes recreation trails, day-use areas, and environmental restoration measures along the lower American. These features were added to this plan because of the opportunities created by the significant levee construction along the lower river.

PLAN ACCOMPLISHMENTS

This plan would increase the level of protection to Sacramento by reducing the probability of flooding in any one year due to levee failure from 1 chance in 100 to 1 chance in 235. Over a 50-year period, it would reduce the chance of flooding from about 40 percent to about 19 percent. (See plate 7.) It would provide about a 94 percent chance of protecting Sacramento during a 100-year storm, 68 percent chance for a 200-year storm, and 30 percent chance for a 400-year storm. (See plate 10.) Modifications to the Sacramento River levee would reduce the probability of flooding in Natomas from levee failure from 1 chance in 140 to about 1 chance in 406. The plan would reduce average annual equivalent flood damages by about 50 percent.

The plan includes construction of day-use facilities in the American River Parkway and additional trails on some of the flood control levees along the lower American River. These facilities would provide an increase of about 500,000 recreation-use days per year. The plan also includes restoring about 100 acres of riparian and upland habitats along the lower American damaged as part of past activities for water resources developments. The plan, in conjunction with policies and practices of local land use planning, would offset adverse impacts on environmental resources directly attributable to construction and operation of project features. Folsom Dam and Reservoir would continue to be reoperated for flood control generally as described under without-project conditions. This plan would increase the ability of Folsom Dam to safely pass the PMF from about 75 percent to 95 percent.

RESIDUAL RISK

With the Stepped Release Plan, the residual flood risk to much of Sacramento would be moderate. Residual flood damages would amount to about 50 percent of the without-project damages. There would be about a 32 percent that major flooding would occur along American River from a 200-year storm with this alternative. The residual flood threat to areas along lower Sacramento River would slightly reduced. Because of the hydraulic mitigation features in this plan, it is expected that there would be no increase in the residual flood threat in the Yolo Bypass.

PLAN COMPONENTS

Folsom Dam and Reservoir

Outlet Modifications and Surcharge Storage. The Folsom Dam and Reservoir component of this plan includes features similar to those in the Folsom Modification Plan. These include:

- Lower crest of main spillway 15 feet and replace main gates
- Extend stilling basin
- Enlarge eight existing river outlets
- Modify surcharge storage operation
- Replace three emergency gates
- Telemeter upstream inflow gages
- Revise emergency flood warning system

Maintain Flood Control Storage Space. In this plan, the flood control diagram for Folsom Reservoir would be modified to reflect continuation of the current reoperation level. Figure V-8 shows a simplified flood control diagram; a detailed diagram is shown in plate 3. A new operation manual would be prepared in accordance with this diagram.

Increase Objective Release. In the stepped operation, the maximum flood release normally would be 145,000 cfs. In rare circumstances, releases would be increased to 180,000 cfs.

Most of the lower American River improvements are designed to accommodate the 180,000-cfs flow. Hydraulic mitigation features downstream from the American are based on a release of 145,000 cfs, however. The objective release would not be increased to 180,000 cfs until inflows to Folsom Reservoir were of the magnitude of about a 175-year storm. Under without-project conditions, a storm of this magnitude would result in flows in excess of 180,000 cfs downstream from the American River. Because conditions below the mouth of the American for these very rare events would be no worse with or without the project, the hydraulic mitigation was limited to the 145,000-cfs release that would be experienced during the more frequent floods.

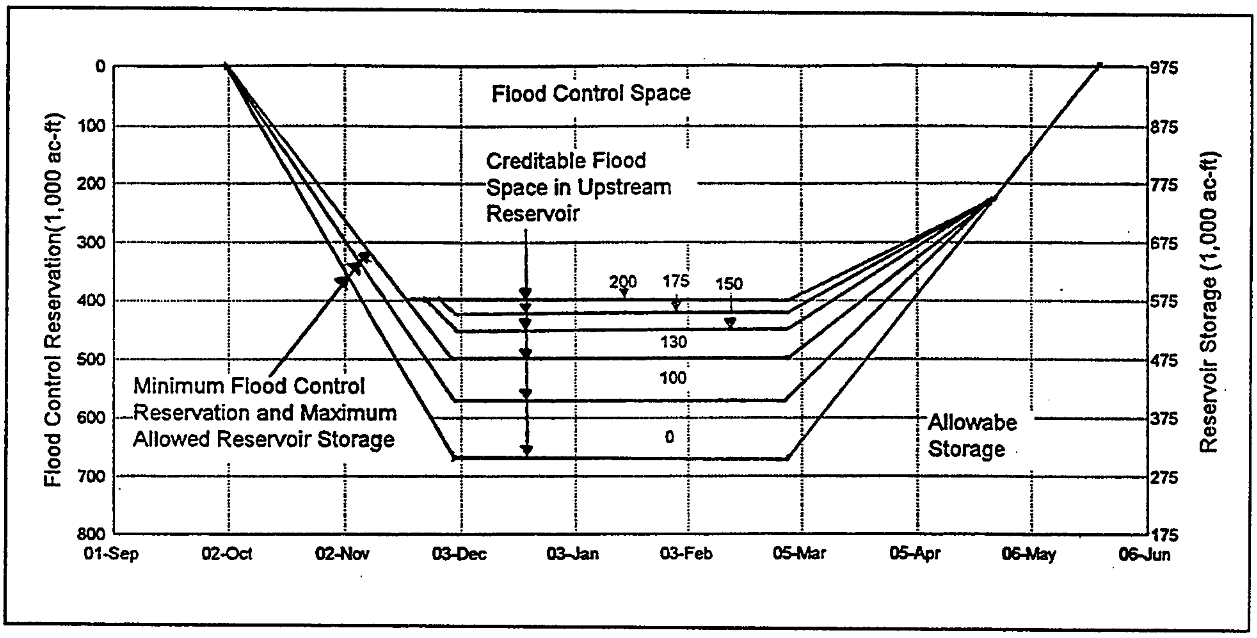


Figure V-8. Flood control diagram for Folsom Stepped Release Plan.

Lower American River

The lower American River components of this plan are shown on plate 15 and include the following work to increase the objective release to 180,000 cfs:

Construct a Slurry Wall in Existing Levees. A slurry wall would be constructed in 25.6 miles of existing levees along the lower American River. (See figure V-5.)

Raise Levees. About 13.5 miles of existing levees would be raised in several locations to pass the objective release's higher water-surface elevation without overtopping the levees. (See figure V-6.)

Riprap Existing Levees. Riprap would be placed along 5.8 miles of existing levees at critical locations to prevent levee erosion due to the higher objective releases. (See figure V-9.)

New Levees and Floodwalls. Work includes constructing 2 miles of new levees and 1.7 miles of floodwalls. (See figure V-10.) An objective release of 180,000 cfs would cause the river to flood areas that are not now flooded at the 115,000-cfs flow. The new levees and walls would protect those areas.

Incorporate Non-Federal Levees. Approximately 2.7 miles of non-Federal levees would be modified to meet current Federal standards and incorporated into the overall flood protection plan.

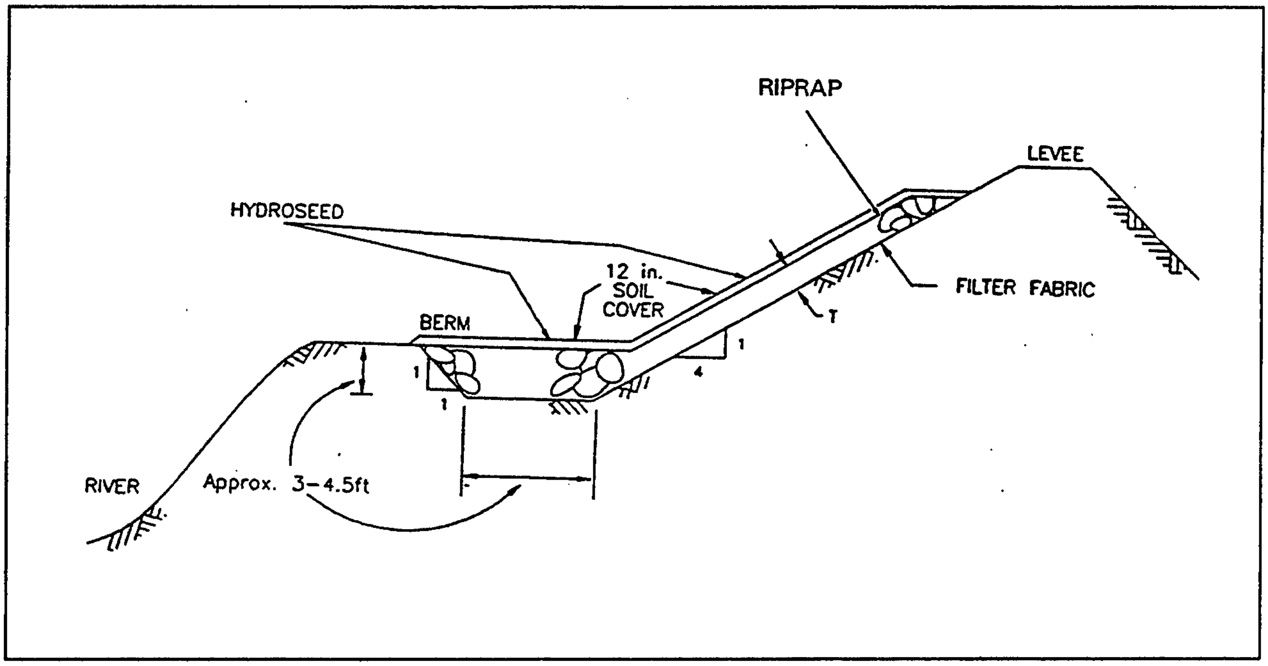


Figure V-9. Typical cross section showing levee riprap protection.

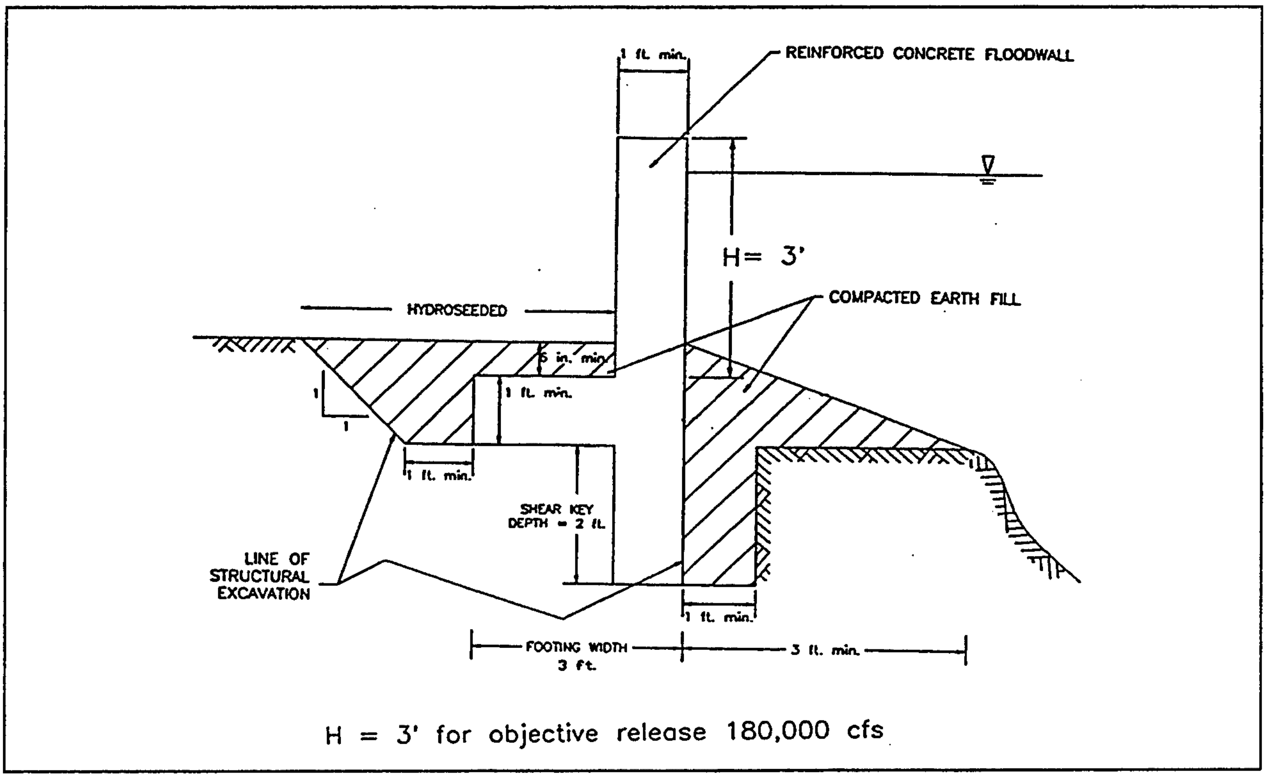


Figure V-10. Typical cross section showing floodwall construction.

Bridge Modifications. In this plan, the Howe Avenue and Guy West Bridges would be raised between 3 and 5 feet. Raising is necessary to safely pass the 180,000-cfs flow. Some minor modifications and a floodgate would be added to the right trestle of the UPRR where the track crosses the north levee below the levee crown.

Modify Utilities and Recreation Facilities. Pumping stations and drainage facilities that were designed to convey drainage from the landside of the levees to the American River with the existing 115,000-cfs release would be modified for the 145,000-cfs release. Other facilities and pipelines in the levees would be raised above the 180,000-cfs design water surface.

Downstream from American River

The downstream component of this plan (see plate 16) includes:

Modify the Sacramento Weir and Bypass. The Sacramento River south of the American River is at capacity during major storm runoff events. Accordingly, to ensure that the higher flows from the American River flow into the Yolo Bypass instead of down the Sacramento River, the Sacramento Weir and Bypass would be modified. (See figure V-11.) The weir would be lengthened 1,000 feet, and the bypass would be widened an equal amount. This widening was sized to accommodate an objective release of 145,000 cfs. The existing north levee would be left generally intact and would be allowed to revegetate to provide wildlife cover areas.

Modify Yolo Bypass Levees. Modifications would be made to structures in the Yolo Bypass to ensure that their reliability is equal to or greater than it would be in the without-project condition. This hydraulic mitigation work includes raising 25.6 miles of the levees, strengthening 38.2 miles of levees, constructing 2 miles of new levees on several tributaries to the bypass, and modifying one bridge over the Tule Canal. (See plate 16.)

Natomas Construction

This plan element consists of raising about 10 miles and strengthening 12 miles of levees on the east side of the Sacramento River downstream from the Natomas Cross Canal. (See plate 14.) These levee improvements would bring the level of protection for Natomas up to that provided by the SAFCA project and a feasible as a last-added increment.

RECREATION PLAN ELEMENTS

This plan includes recreation features at two locations—Gateway Park and Richards Boulevard area. A layout of the plan areas is included in plate 9.

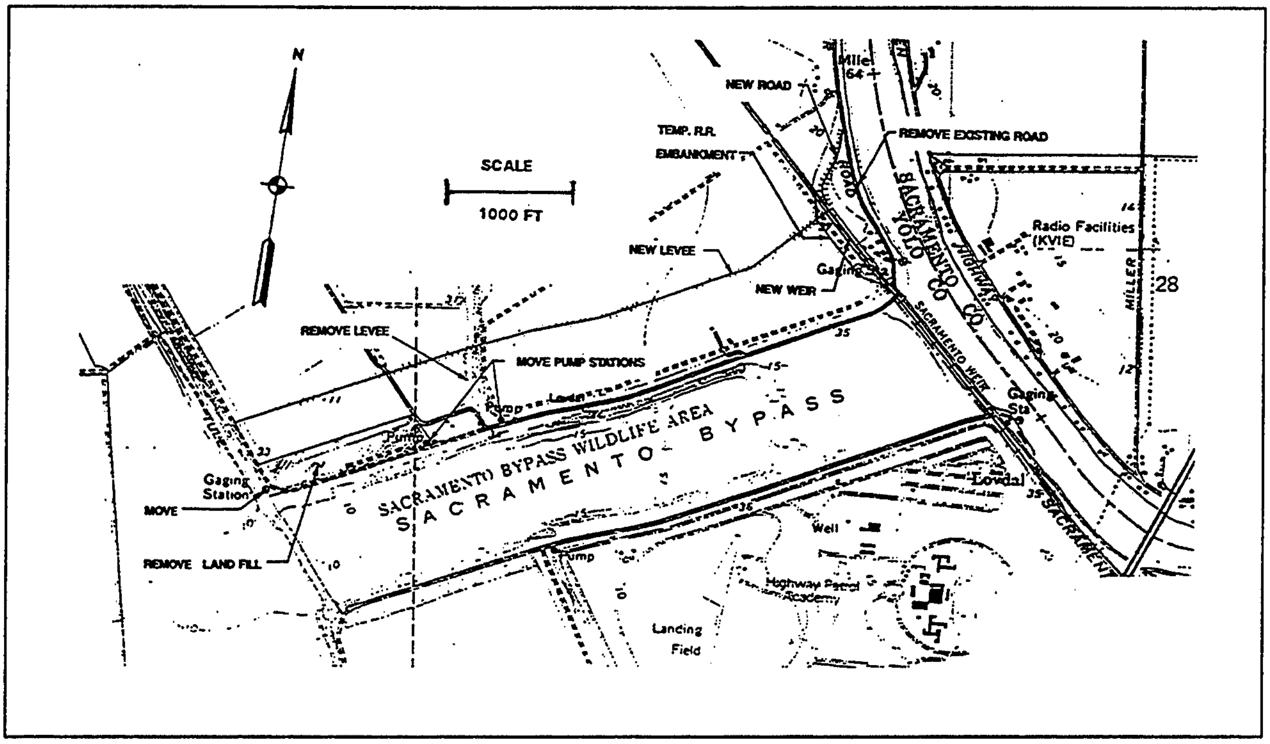


Figure V-11. Sacramento Weir and Bypass modifications.

Gateway Park

The area proposed for development of Gateway Park is situated on the north bank of the American River between State Route 160 and the Union Pacific Railroad tracks. This site is on project lands (American River floodway), and it is located between Federal levees which would be improved for the Stepped Release Plan. Water- and land-based recreation would be in a natural setting of river, wetlands, and riparian vegetation. The recreation plan includes development of a bicycle trail and bridge to link with nearby trails, boat launch facilities, fishing pier, swimming beach, equestrian staging facility, group picnic sites, interpretive kiosks, sports field, restrooms, and parking areas. Gateway Park is part of the American River Parkway Plan and would provide significant recreational opportunities for the Sacramento area.

Richards Boulevard Area Recreation Trail

This element consists of an 8-mile-long recreation/bicycle commuter trail on the levee on the south side of the American River. The trail would connect Tiscornia Park (at the American River's confluence with the Sacramento River) with CSUS. The new trail would be an important addition to the American River trails system because it would link to other trails at both the park and at the university. The trail would also link Glen Hall and Sutter's Landing Parks.

Some sections of the trail would be routed on the riverside of the levee (on floodway lands) to preserve the privacy of residents on the landside. Most of the trail would be routed on top of a Federal levee that would be improved in the Stepped Release Plan. The recreation trail development includes a park of about 10 acres on the south side of the river at the terminus of 7th Street. The park would serve as a major access point to the parkway and new trails from the downtown area.

ENVIRONMENTAL RESTORATION ELEMENT

This plan also includes environmental restoration at two sites—Woodlake Area and Urrutia Property. The goal is to restore, to the extent possible, fish and wildlife habitat values adversely affected by previous activity associated with the existing Federal flood control project. Both sites are north of the American River, within the parkway, between Interstate 5 (Discovery Park) and H Street. They are shown on plate 9. They are included in this plan because of the extensive work along the lower American River for flood control.

Woodlake Area

The Woodlake area includes portions of the parkway between Discovery Park and the SPRR and scattered wetlands between Interstate 80 and the H Street Bridge. Borrow material for the nearby levee work would be taken from this site to lower the area to flood periodically and revert to wetlands. In addition to excavation, the site would be contoured to produce a variety of wetland habitats. Only minimal planting and management would be required as the site likely would revegetate on its own. The Woodlake area is promising for restoration due to the presence of fertile soils and water from a number of local drainages. In addition, the site is large enough for habitat enhancement on a workable scale and is close to levee improvement sites.

Urrutia Property

The Urrutia property is located immediately west of the Woodlake area and east of Discovery Park. It is privately owned and has been mined for topsoil and sand. The excavated pit is 57 acres large and 25 feet deep. The pit has filled with water through subsurface seepage from the American River. The resultant "lake" has little habitat value since its side slopes are very steep and lack vegetation. Wetland habitat can be created at the lake's edge by creating a gently contoured slope. The borrow created by grading back the side slopes would be used to create shelves at the lake's edge and islands for emergent wetland habitats. The lower elevations of the resultant wetlands would be flooded more frequently and would be dominated by seasonal wetland habitats, whereas the upper elevation would be flooded less frequently and would be dominated by riparian habitats.

DESIGN AND CONSTRUCTION CONSIDERATIONS

Folsom Dam and Reservoir

The outlet modifications and surcharge storage features are designed to increase the reservoir efficiency and avoid impacts, as discussed for the Folsom Modification Plan.

Lower American River

Design Water-Surface Elevation. Although for most situations the objective release would be 145,000 cfs, modifications to the existing system are based on the maximum release of 180,000 cfs. This is to ensure that the system will work under all anticipated conditions. R&U procedures were used to select design parameters for the system—PNP of 51 feet and PFP of 52 feet. The PNP is approximately 2 feet above the average water-surface elevation expected with the 180,000-cfs release and accounts for the uncertainty associated with future operation of the system. An additional factor was added to the PFP to account for wind-wave runup and prevent levee overtopping.

As with the previous plan, to reduce impacts to vegetation and adjacent private property, existing levees would be strengthened with a vertical slurry cutoff wall. Sections of the existing Federal and non-Federal levees would be raised to the PFP elevation. Where possible, work would be done to avoid impacts to surrounding habitats. Levee raising would be during the nonflood seasons to ensure no loss of flood protection during the flood season.

The higher objective release would subject some areas upstream from the existing project levees to flooding, so new levees or floodwalls would be required to protect these areas. Locations for the new levee were determined by comparing the existing ground elevations of upstream areas with the water stages corresponding to the design PFP profile. The levees were sited to avoid impacts to wildlife habitat when possible. Where space would not permit construction of new levees, floodwalls would be constructed.

Erosion Control. The higher objective release would require protection for some of the existing levees against potential erosion caused by higher overbank flow velocities. Protection would be provided by placing stone revetment on recommended levee reaches, which were identified as potential erosion sites if (1) the levee would be subjected to high-velocity flow, (2) the river is highly constricted and the levees might be subjected to high flow velocities, or (3) damages to the levees have been observed in previous floods.

Minimize Impact to Traffic and Recreation. Howe Avenue Bridge is a major crossing of the American River. To minimize impacts to traffic, one side of the bridge would be raised at a time. Traffic would continue during construction but would be reduced to one lane each way. Much of the construction would be within the American River Parkway, a heavily used facility. To reduce impacts to trail users, the work would be done in phases and appropriate detours would be provided.

Downstream American River

With the higher objective release from the American River, the Sacramento Weir would need to be lengthened approximately 1,000 feet and the Sacramento Bypass widened a similar distance. These modifications would result in greater floodflows into the Yolo Bypass and a decrease in reliability of the Yolo Bypass levees. So to offset the impacts of these higher flood stages, the plan includes raising about 26 miles of levee in the bypass, strengthening 38 miles, constructing 2 miles of new levee, and modifying a Yolo Shortline Railroad bridge over the Tule Canal.

The modification is based on an objective release of 145,000 cfs because release of the maximum 180,000 cfs would be used only in rare, very large floods. During such rare events (under the without-project condition), even with levee failures on the lower American River, flows reaching the Sacramento River would be in excess of 180,000 cfs. With this plan, the more frequent, smaller floods, controlled to a 145,000-cfs objective release, would deliver higher volumes of water to the downstream areas than would have occurred without the project. Therefore, modifications are required to the Sacramento Weir and Sacramento Bypass to ensure the reliability of these structures.

Natomas

The Natomas improvements being constructed by SAFCA are compatible with or exceed the requirements of the Stepped Release Plan. As with the previous plan, additional work on the east bank of the Sacramento River was identified using R&U analysis.

ENVIRONMENTAL IMPACTS AND MITIGATION

Direct Construction Impacts

Folsom. The construction of the outlet improvements at Folsom would have some temporary impacts on air quality, traffic, and noise. However, these impacts would be mitigated by best management and construction practices. Because this plan does not include a change in Folsom Reservoir's operation, there would be no long-term operation impacts.

Lower American River. The construction of levee, bridge, and related infrastructure modifications for flood control and channel modifications for environmental restoration along the lower American River would have temporary impacts on traffic, air quality, and noise. In addition, project construction and impacts in the borrow area would amount to a loss of about 37 acres of mixed habitat. Mitigation for this loss would consist of enhancing habitat on 94 acres in the American River Parkway; 38 acres of riparian habitat at the Woodlake site and 56 acres of oak habitat near Cordova Park. Potential impacts on cultural resources would be mitigated by a survey and retrieval program prior to construction activities.

Downstream from American River. The construction of these improvements, including widening the Sacramento Weir and modifying levees (footprint impacts and borrow and spoil areas), would affect 138 acres of mixed habitat. Mitigation would include participating with The Reclamation Board to restore 116 acres on a portion of Liberty Island being acquired by the State. The remaining oak mitigation would be included at the Cordova Park site on the American River.

Natomas. Work along the Sacramento River in Natomas and resultant impacts are the same as for the Folsom Modification Plan.

OPERATION AND MAINTENANCE CONSIDERATIONS

As with the Folsom Modification Plan, the local sponsor would be responsible for the operation, maintenance, replacement, and rehabilitation of the project. For existing Federal facilities, the sponsor would be responsible for the increased O&M costs associated with project improvements.

Operation

The operation of the Stepped Release Plan would be accomplished in a manner similar to the existing system. Reclamation, in coordination with the State Flood Operations Center, would operate the Folsom component of the plan, while the various districts and agencies that operate and maintain the American River floodway and levees would operate the downstream components.

Maintenance

The periodic maintenance for levees, floodwalls, and related facilities would be described in an O&M manual and would be similar to that described for the previous plan.

SAFCA has sponsored recreation and environmental restoration studies for this plan and thus is currently identified as the local sponsor. The Sacramento County Department of Parks and Recreation could also be a sponsor and could assume O&M responsibilities for these features.

RELATIONSHIP WITH OTHER AREA FACILITIES

Folsom Spillway Adequacy

With the plan features, Folsom Dam could pass about 75 percent of the PMF with 5 feet of freeboard and 95 percent with no freeboard.

Folsom Dam and Reservoir Reoperation

The plan is compatible with the without-project conditions and assumptions for this report. SAFCA has requested that, should this plan ultimately be selected for implementation, costs associated with continued reoperation be included in the Federal project and shared in accordance with other features.

West Sacramento Project

The West Sacramento Project would be affected slightly by the Stepped Release Plan when, on rare occasions, releases from Folsom Dam would be higher and the American River system would pass increased flows to the Yolo Bypass, past the West Sacramento Project. Overall, however, this plan would be compatible with the West Sacramento Project upon completion of the hydraulic mitigation work at the Sacramento Weir and in the Sacramento and Yolo Bypasses.

Sacramento River Bank Protection Project

As with the Folsom Modification Plan, the Stepped Release Plan would be consistent with ongoing bank protection and erosion control efforts on the Sacramento and American Rivers.

Sacramento and American Rivers Flood Control Projects

The Sacramento River Flood Control Project would not be significantly affected by this plan. The plan includes features to offset the effects of increased objective releases.

Natomas Project

The ongoing construction in Natomas by SAFCA is compatible with the features and operation of this plan and would raise the level of protection in Natomas.

Central Valley Project

Continued reoperation of Folsom Dam and Reservoir would slightly reduce the ability of the CVP to deliver water and power. However, this would occur with or without the plan. Impacts to natural and cultural resources associated with reoperation will be mitigated under the existing agreement between SAFCA and Reclamation.

PLAN ECONOMICS

Estimates of costs and benefits for this plan are based on October 1995 price levels, 7⅝ percent interest rate, and 100-year period of analysis. Construction would begin in the year 2000 and be completed in 2007.

Costs

The estimated first and annual costs of this plan are summarized in table V-5. The total estimated first cost is $522 million, and the estimated average annual cost is $64 million.

Benefits

As shown in table V-6, the total average annual benefits are approximately $102 million. This includes flood control benefits over the project economic life (including flood damage reduction and transportation disruption benefits) of $78.4 million and benefits prior to the base year (2008) of $18.6 million. The annual benefits attributable to recreation and environmental enhancement are about $3.5 million. Also included are benefits of about $1 million associated with replacement of Howe Avenue Bridge. Additional information on the benefit analysis is contained in Appendix C, Economics.

Economic Justification

Overall Feasibility. The estimated net annual benefits for the Folsom Stepped Release Plan are about $37.5 million and the benefit-cost ratio is 1.6 to 1.

Incremental Analysis. Federal planning policy requires that (1) physically separable elements of a project be economically feasible in order to receive a Federal contribution in its cost and (2) major project features be feasible as a last-added increment. For this plan, elements along the lower American River and downstream, the Natomas levee improvements, recreation features, and environmental enhancement features are considered as last-added increments to the Folsom Dam modifications.

American River and Downstream American River Levee Modifications. The first cost of the plan elements creditable to levee improvements along the lower American River (exclusive of the slurry wall, which was shown to be incrementally feasible, discussed in chapter IV) and downstream amount to about $325.2 million. The resulting average annual cost is approximately $35.2 million. The estimated incremental average annual flood control benefit attributable to the levee increment associated with increasing the objective release from Folsom Dam is about $28.4 million. Since the costs are greater than the benefits, this increment of the project plan is not incrementally feasible, and Federal participation in cost sharing is limited.

Natomas Levee Modification. The first cost of this plan creditable to Natomas is $13 million. The resulting average annual cost is $1.8 million. The average annual flood control benefit for Natomas as a last-added increment is $23.1 million. Since the benefits are greater than the costs, the Natomas features are economically feasible as a last-added increment.

TABLE V-5

Stepped Release Plan - Cost Estimate
($ million)

Item	Total Previously Expended Thru FY 96	Folsom Dam & Reservoir	Lower American River	Downstream American River	Natomas Area	Total
First Cost [1]						
Lands and management		0.0	38.1	1.8	1.5	41.4
Roads and relocations		0.1	35.4	28.2	0.0	63.6
Dam		109.1	0.0	0.0	0.0	109.1
Levee modifications		0.0	100.0	65.4	9.3	174.7
Recreation		0.0	3.3	0.0	0.0	3.3
Environmental restoration		0.0	6.4	0.0	0.0	6.4
Cultural resources		1.3	1.4	1.2	0.1	4.0
Environmental mitigation facilities		0.0	3.4	8.7	0.0	12.1
E, D, S, and A	15.0	26.0	43.3	20.4	2.1	106.9
Total	15.0	136.5	231.3	125.7	13.0	521.5
Investment Cost						
First Cost	15.0	136.5	231.3	125.7	13.0	521.5
Interest during construction	19.9	178.1	75.2	17.3	11.2	301.7
Total	34.9	314.6	306.5	143.0	24.2	823.2
Annual Cost [2]						
Interest and amortization	2.7	24.0	23.4	10.9	1.8	62.8
Operation and maintenance	0.0	0.2	0.6	0.4	0.0	1.2
Total	2.7	24.2	24.0	11.3	1.8	64.0

[1] October 1995 price levels.

[2] 100-year economic project life and 7⅝ percent interest rate.

TABLE V-6

Economic Summary of Folsom Stepped Release Plan

Item	($ million)
First Cost	521.5
Annual Costs [1, 2]	64.0
Annual Benefits [2]	
Flood control	
Inundation reduction [3]	78.4
Benefits prior to base year	18.6
Bridge replacement	1.0
Recreation	2.1
Environmental restoration [4]	1.4
Total	101.5
Net Annual Benefits	37.5
Benefit-to-cost ratio	1.6

[1] Includes IDC.
[2] 100-year economic project life and 7⅝ percent interest rate.
[3] Inundation reduction benefits including future growth through project life.
[4] Benefits for environmental restoration are estimated to equal costs.

Recreation Element. The estimated first cost for the recreation features is $3.8 million. The estimated average annual costs amount to $400,000. With average annual recreation benefits amounting to $2.1 million, the estimated net benefits amount to $1.7 million.

Environmental Restoration Element. The estimated first cost for the environmental restoration features is $17.1 million. The estimated average annual costs amount to $1.4 million. Benefits associated with restoration are generally intangible and so are defined here as being equal to the costs.

IMPLEMENTATION

Features and Costs

As with the Folsom Modification Plan, successful implementation of this alternative would include constructing the above mentioned physical features as well as formalizing

long-term agreements to permanently increase the flood control storage space from the 400,000 acre-feet fixed space (without-project condition). This agreement would need to include features to replace, or mitigating water related resources adversely impacted due to reoperation. The incremental elements for Federalizing permanent reoperation are described in chapter VII.

As mentioned, the total first cost for this alternative (see table V-5) is about $522 million. In addition to this cost, would be the cost to Federalize permanent reoperation of Folsom Dam and Reservoir. Using replacement quantities and unit values described in chapter VII, the estimated equivalent first cost for the resources replacement amounts to about $105 million. The bulk of this estimated cost, however, is the replacement cost for water supply which could be significantly different depending on actual methods of implementation. The total estimated cost to implement this plan amounts to $627 million.

Cost Sharing

Table V-7 shows the estimated cost sharing between the Federal Government and the non-Federal sponsor, should this plan be selected for implementation. Of the $522 million total first cost (less permanent reoperation costs), $95 million would be Federal and $427 million non-Federal costs. Planning guidance indicates that, lacking significant justification to the contrary, added project measures, or increments, need to be economically feasible (benefits exceeding costs) in order to warrant Federal participation in their costs. Even though the total net economic benefits for this plan exceed costs, several major features of the plan are not incremental feasible. These features include lowering the spillway at Folsom Dam, modifications (other than slurry wall) of levees along the lower American River, and modifications to the Sacramento Weir and Sacramento and Yolo Bypasses. Because of this, Federal participation in these increments would be restricted. As shown in table V-7, of the total costs for flood control about 17 percent ($87 million) is considered incremental economically feasible. The remaining 83 percent ($422 million) is not incremental feasible. Accordingly, the costs for these features would be borne by the non-Federal sponsor. Also included in table V-7 is the allocation of first costs for the recreation and environmental restoration elements of the Stepped Release Plan.

Table V-7 also shows the total cost of this plan including costs associated with permanently reoperating Folsom Dam and Reservoir. The equivalent first cost for the permanent reoperation increment is $105 million. Assuming these costs would be cost shared 75 percent Federal and 25 percent non-Federal, of the total cost for this plan, $174 million (29 percent) would be funded by the Federal Government and $453 million (72 percent) would be a non-Federal cost.

TABLE V-7

STEPPED RELEASE PLAN - COST APPORTIONMENT [1]
($ million)

Item	Federal	Non-Federal	Total	Federal	Non-Federal	Total	Total: Federal	Total: Non-Federal	Total: Total
Flood Control	Initial Increment			Non-Federal Increment					
First Cost	137.3	3.5	140.8	0	359.0	359.0	137.3	362.5	499.8
Cash Adjustment	-31.7	31.7	0	0	0	0	-31.7	31.7	
Total	105.6	35.2	140.8	0	359.0	359.0	105.6	394.2	499.8
Percent	75	25		0	100		21	79	
Recreation & Environmental Restoration	Recreation			Environmental Restoration					
First Cost	4.0	1.0	5.0	7.6	9.1	16.7	11.6	10.1	21.7
Cash Adjustment	-1.5	1.5		4.9	-4.9		3.4	-3.4	
Total	2.5	2.5	5.0	12.5	4.2	16.7	15.0	6.7	21.7
Percent of First Cost	50	50		75	25		69	31	
Total First Cost [2]							120.6	400.9	521.5
Percent of First Cost							23	77	
With Federalization of Folsom Reoperation									
Permanent Reoperation [3]							79.0	26.3	105.3
Total First Cost							199.6	427.2	626.8
Percent of First Cost							32	68	

[1] 1995 price levels.
[2] Total flood control, recreation, and environmental restoration.
[3] Permanent Folsom reoperation allocated 75 percent Feeral and 25 percent non-Federal.

DETENTION DAM PLAN

GENERAL DESCRIPTION

The principal feature of this plan is a 508-foot-high flood detention dam on the North Fork American River near Auburn. The plan also includes (1) returning to the 400,000 acre-feet of fixed flood control space in Folsom Reservoir, (2) strengthening existing levees along the lower American River, and (3) strengthening and raising levees in Natomas along the east side of the Sacramento River between the Natomas Cross Canal and the American River.

PLAN ACCOMPLISHMENTS

This plan would increase the level of protection to Sacramento by reducing the probability of flooding due to levee failure from 1 chance in 100 to less than 1 chance in 500 in any year. Over a 50-year period, it would reduce the chance of flooding from without-project conditions from 40 percent to about less than 8 percent. The plan would provide nearly a 100 percent chance of protecting Sacramento during a 100-year event, 97 percent chance for a 200-year event, and 82 percent chance for a 400-year event. Modifications to the Sacramento River levee would reduce the probability of flooding in Natomas from levee failure from about 1 chance in 140 to 1 chance in 400.

The plan would reduce average annual equivalent flood damages about 80 percent. The plan includes features that, in conjunction with policies and practices of local land use planning, would offset adverse impacts on environmental resources directly attributable to construction and operation of project features. This plan would increase the ability of Folsom Dam to safely pass the PMF without freeboard from about 75 percent to 100 percent.

RESIDUAL RISK

The residual flood risk to much of Sacramento and in Natomas would be very low with this alternative. Residual flood damages would amount to about 20 percent of the without-project damages. The chance of flooding from a 200-year storm would be nearly zero (3 percent). The residual flood threat to areas along lower Sacramento river would only be about 10 percent of without-project conditions. In the Yolo Bypass, the residual flood threat would remain relatively high.

PLAN COMPONENTS

Detention Dam Area

The major plan component in the upper basin is a peak-flow flood detention dam to be located at river mile 47.2 (about 800 feet downstream from Reclamation's multipurpose damsite) on the North Fork American River near Auburn. The dam would provide a detention capacity of 894,000 acre-feet. At full capacity, the flood pool elevation would be 942 feet and floodwaters backed up by the dam would cover about 5,500 acres. Except during rare flood periods lasting several days, the area behind the dam (river canyon) would be dry and look much as it does today. There is only about a 22 percent chance of reaching full pool over the 100-year economic life of the project.

From the streambed, the dam would be about 508 feet high. It would be a concrete gravity structure (placed with roller compaction techniques) about 400 feet wide at the base and decreasing to about 25 feet at the top. The dam would be 2,700 feet long at the crest and have a total volume of about 7.6 million cubic yards. Plate 17 shows the gross pool detention boundary behind the dam, plate 18 shows a plan view of the dam, and plate 19 shows the dam in section and profile.

Flood releases would pass through 20 sluices (measuring 5 feet by 10.5 feet) through the dam. The combined releases of these sluices at gross pool would be 77,000 cfs. The large number of sluices would allow smaller, more frequent floods to pass through the dam without storing water. The existing diversion tunnel constructed for Auburn Dam would be closed with a concrete plug.

Each sluice would be fitted with an emergency closure gate and a operational gate. (See plate 20.) The gates in the sluices would be used to control the drawdown rate of large floods to reduce the potential for sloughing of the canyon walls. They would also be closed to retard flows from the dam in the extremely unlikely event of an emergency affecting the safety of the dam and/or the downstream flood control system. Such safety related conditions could include (1) at the detention dam—damage to one or more sluiceways affecting the structure; (2) at Folsom Dam—a seismic event damaging Folsom Dam and affecting its capacity to store or discharge water, and (3) along the levees—a flood event that would cause imminent levee failure. In addition, bulkheads would be available to block the sluices for inspection and maintenance.

During normal conditions, the gates would remain open. The gates would not be used to permanently store water in the detention area. In most years, no water would pool behind the dam, and pooling during a major storm would be for short durations. For example, during a 5-year storm (20 percent chance of occurring in any year), water would pool to a depth of about 35 feet at the dam for less than 1 day. During a 100-year storm (1 percent chance in any year), the pool depth could reach about 340 feet for 1 day. The total time for the detention area to fill to this depth at the dam and then empty would be

about 15 days. The chance of this occurrence is about 64 percent over the 100-year period of analysis.

The project would require 6,000 acres of land in the detention dam area. (Additional lands would be required along the Yuba River for environmental mitigation as described later in this chapter.) These lands include about 260 acres in fee title and 5,740 acres in flowage easements for occasional flooding. In addition, about 100 acres within the flowage easement limits would be needed for temporary construction easements and about 50 acres for road easements. Approximately 75 percent of the lands within the project area are Federally owned and would be retained in Federal ownership.

The non-Federal sponsor would need to acquire flowage and road easements from private landowners and Reclamation. The sponsor would also need to acquire fee lands for fish and wildlife mitigation and permanent road easements for relocation of Highway 49 and Ponderosa Way. The Corps would obtain jurisdiction over the lands currently held by Reclamation which are needed for the dam and embankment. The Corps would also obtain the necessary rights-of-way or negotiate agreements for those lands currently under the jurisdiction of the U.S. Bureau of Land Management and U.S. Forest Service. The Corps would take this action because right-of-way issued to a Federal agency cannot be altered or revoked without agency consent.

Periodic inundation of the canyon upstream from the dam would interrupt traffic on Highway 49 and, to a lesser extent, on Ponderosa Way. The frequency of inundation and potential for road damage would warrant relocation of Highway 49. The selected relocation comprises a two-lane bridge across the American River as close as practicable to the existing highway alignment at each side of the canyon. (See plate 21.) The bridge would be at about elevation 1,000 feet. Ponderosa Way would be inundated infrequently and has significantly less use. Work would be done on the bridge and approaches to allow Ponderosa Way and bridge to withstand periodic inundation.

Folsom Dam and Reservoir

Folsom Reservoir operation would return to the 400,000 acre-feet of fixed flood storage from the 400,000/670,000 acre-feet in the without-project operation. The objective release would remain at 115,000 cfs. Figure V-12 shows a simplified flood control diagram for this operation.

Telemeter Upstream Inflow Gages and Emergency Flood Warning System

This work includes construction or modification of telemetered gaging stations upstream from Folsom Reservoir on the three main forks of the American River and implementation of operation changes to use data from the gages to enhance the real-time operation of Folsom during a storm. An improved automated flood-warning system along the lower American River is included to facilitate emergency evacuation of the floodway.

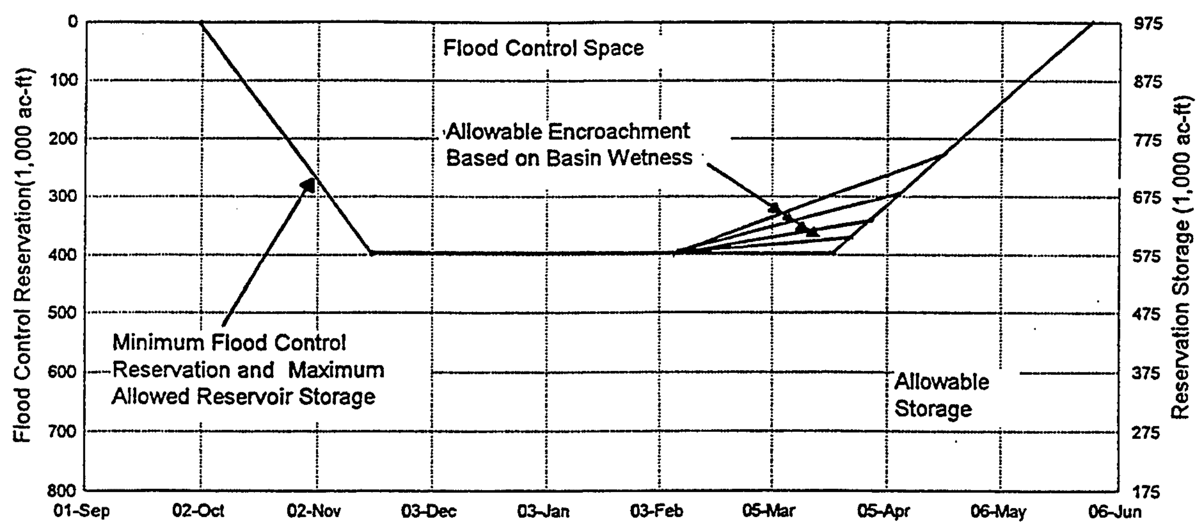


Figure V-12. Folsom Flood Control Diagram - Detention Dam Plan

Lower American River and Downstream

Work along the lower American River would be essentially the same as described for the Folsom Modification Plan. It would consist of a slurry wall in the center of the existing levee. With new flood storage upstream, the existing objective release at Folsom would control larger floods, thus reducing floodflows in the lower American River and areas downstream. Because the levees in these downstream areas would not be subjected to higher releases for a given magnitude of flood, their reliability would be improved. Therefore, no hydraulic mitigation features would be required.

Natomas

The downstream component of this plan includes raising about 10 miles and strengthening 12 miles of levees on the east side of the Sacramento River downstream from the Natomas Cross Canal, similar to the Folsom Modification Plan. These levee improvements are included to bring the reach up to a level of protection for Natomas comparable with the SAFCA plan.

DESIGN AND CONSTRUCTION CONSIDERATIONS

Detention Dam Area

A major consideration for the detention dam was to use as much as possible of the existing construction work accomplished by Reclamation. Existing work that could be used includes the remaining section of the cofferdam, the diversion tunnel, some of the foundation work for the main dam, and access roads. The tunnel would be used to divert water during construction. Also, some of the detailed exploration and engineering design information developed for the site by Reclamation would be used for project design.

Full consideration has been given to the seismicity of the river mile 47.2 site in the preliminary design of the flood control dam. The seismic design parameters used were a maximum credible earthquake of magnitude 6.5 with a peak ground acceleration of 0.64 g (acceleration of gravity) in the horizontal direction and 0.39 g in the vertical direction. In addition, the design used a fault displacement of 9 inches. With the present alignment, the dam is not located on the surface trace of the fault in the footprint of the original arch dam. A slight curvature in the dam alignment has been provided, and concrete strengths in the dam would be sufficient to withstand stresses during the design seismic event.

Approximately 7.6 million cubic yards of concrete would be used in constructing the dam. Most of this volume would be for aggregate. This aggregate would be obtained from three sources: (1) remnants of the existing cofferdam, (2) a gravel bar immediately downstream from the damsite, and (3) an area on the left abutment to the dam. Processed material would be transported from the points of extraction by a conveyor belt system to the construction site.

Highway 49 replacement would be in-kind with a bridge and road generally along the river mile 50.1 alignment. (See plate 21.) This would affect 47 acres of land in the area. There would be no indirect impacts related to this relocation in northwestern El Dorado County since the commute times would not be significantly reduced. The State, as a non-Federal sponsor, would be responsible for this relocation. The proposed action would be reviewed by the California Transportation Commission. Given the long-term needs of the State to consider a major relocation of the highway in the Auburn area, route adoption studies would be conducted by the State. As part of this process, additional environmental analysis could be performed.

The existing Highway 49 bridge crossing of American River would be abandoned, although access to the canyon on the existing alignment would be maintained for recreation. The non-Federal sponsor has indicated its willingness to participate with Placer County in efforts to maintain the existing bridge and access roads for recreation and public safety.

Allowance for a "dead pool space" for sediment would not be required mainly because only small amounts of material would likely reach the damsite. Sediment yield studies described in chapter VI of the December 1991 Hydrology Appendix indicate that

about 26,000 acre-feet of material could reach the damsite over 100 years. Most would pass through the outlet sluices. Even if a large portion did not pass the damsite, this amount of sediment relative to the flood control storage is insignificant.

Reclamation and PCWA are planning to construct a pump station in the canyon at the Auburn site to deliver water to PCWA's Ophir Tunnel for distribution to county water users. Since the detention dam would affect that pump station, the two projects would need to be coordinated to ensure their efficient construction and operation.

Lower American River

Design and construction procedures for construction of the slurry wall along the lower American River would be similar to the Folsom Modification Plan.

Natomas

Design and construction considerations for the Natomas increment of the project would be similar to the Folsom Modification Plan.

Coordination With State Dam Safety Officials

During design and construction of the project, the Corps would coordinate with the DSOD (State of California Division of Safety of Dams). Under the Water Resources Development Act of 1986, the detention dam, upon completion, would be under the jurisdiction of DSOD. Before the non-Federal sponsors could operate the detention dam, a Certificate of Approval would be required. DSOD would have to be satisfied that geotechnical exploration, design, and construction are adequate. The Corps SPD Regulation 1110-1-7 and DSOD Procedure No. 3-4 cover the coordination.

ENVIRONMENTAL MITIGATION

Without mitigation, the Detention Dam Plan would adversely affect environmental resources in the project area. These impacts and measures to mitigate them are described in the DSEIS/SDEIR and highlighted below.

Direct Construction and Operational Impacts

Detention Dam Area. The Detention Dam Plan would result in impacts in the American River canyon due to construction and operation. About 313 acres of vegetation would be lost as a result of construction activities at the damsite and from replacing Highway 49. Operation of the detention dam would result in the loss of vegetation equivalent to about 1,369 acres of various habitats over the project life as a result of vegetation mortality from repeated inundation. Mitigation would consist of purchasing and improving about 4,440 acres of land in the American River canyon and along the Yuba

River. Approximately 1,480 acres in the canyon inundation zone would be treated under the adaptive management plan. This includes planting 7,008 elderberry seedlings for mitigation of lost habitat for the valley elderberry longhorn beetle, a threatened species. Approximately 2,960 acres of land would be purchased from willing sellers along the Yuba River and planted with riparian and upland species. (See plate 22.)

Returning to the 400,0000 acre-feet fixed flood control operation would provide an increase in benefits to water supply, hydropower, recreation, and fish and wildlife resources at Folsom and in the lower American River.

Impacts to historic, prehistoric, and paleontological resources would also be mitigated. Mitigation will consist of data recovery and documentation. Mitigation actions for cultural sites would be guided by a programmatic agreement with the State Historic Preservation Officer.

Potential impacts to traffic, noise, and air quality due to project construction would be mitigated by best management and construction practices to be less than significant.

Lower American River. Work along the lower American River and impacts are the same as described for the Folsom Modification Plan.

Natomas. Work along the Sacramento River in Natomas and impacts are the same as described for the Folsom Modification Plan.

Indirect Impacts

No significant growth-inducing impacts are expected either along the lower American River or in Natomas. Although Highway 49 and approaches would be raised above the detention dam's gross flood pool elevation, the crossing would still be well within the canyon area and would not significantly reduce the travel time between Auburn and northwestern El Dorado County.

OPERATION AND MAINTENANCE CONSIDERATIONS

Once the project was complete, ownership would be transferred to the local sponsor. The local sponsor would then be responsible for the operation, maintenance, replacement, and rehabilitation of the project in accordance with the water control manual, O&M manual, and initial flood inundation plan.

Operation

Operation of the detention dam would be required during floods that would cause a flood pool to rise behind the dam. During the flood season, the gates on the bottom outlet sluices would be left open to pass frequent floods. The gates would be operated to achieve a

controlled drawdown rate during the draining part of the flood cycle. That controlled drawdown rate would be 1.5 feet per hour above elevation 650 feet, and 3.5 feet per hour below elevation 650 feet to minimize the potential for inundation-induced landslides or sloughing.

The gates would be inspected periodically, normally during the summer. Of the 20 outlet sluices, 2 would be at streambed elevation. These two would be the first gates to be closed during a major flood event to avoid abrasive erosion from bedload moving through these sluices at high heads and velocities. This would allow normal low flows without backing up water in the detention area. These low-level sluices would be closed annually for up to 2 days each year for inspection and maintenance. There would be no permanent pool upstream from the dam. Additional information on the gates is included in appendix G.

Folsom Dam would be operated as it was prior to the SAFCA/Reclamation reoperation agreement. Peak floodflows into Folsom Reservoir would be less, due to the additional upstream storage. During flood conditions, the storage in Folsom would fluctuate less than under existing conditions because of the effects of the new dam. The water control manual for Folsom Dam would be modified to reflect the coordination required to use the additional upstream storage.

Maintenance

The periodic maintenance of the project would be described in an O&M manual prepared by the Corps. All O&M activities would be paid for and accomplished by the non-Federal project sponsors. The non-Federal sponsors would be required to provide the Corps with a semiannual report describing O&M accomplishments.

Detention Dam Area. Maintenance of project features on the main stem American River would consist of:

Structure Maintenance. Periodic inspection and maintenance of the dam structure, outlet works, and spillway.

Adaptive Management Plan. An adaptive management plan would be implemented as part of the O&M manual. When impacts, primarily to vegetation, occur as a result of flood inundation, this plan would include features to ensure the vegetation lost would be replaced. Under the plan, mechanisms for identifying project-induced impacts would include establishing a baseline information database for preinundation conditions and a monitoring program for identifying impacts. In addition, the plan would provide a mechanism for determining appropriate mitigation planting measures for identified impacts and an implementation process. In addition to habitat mitigation, minor roads and trails currently used for river access and general area recreation would be periodically restored as needed for inspection purposes and vegetation maintenance.

Lower American River and Natomas. Maintenance requirements for levees along the lower American River and Sacramento River on the west side of Natomas would be the same as for the Folsom Modification Plan.

RELATIONSHIP WITH OTHER AREA FACILITIES

Folsom Spillway Adequacy

With the detention dam, Folsom Dam could pass about 90 percent of the PMF with 5 feet of freeboard and 100 percent with no freeboard.

Folsom Dam and Reservoir Reoperation

Reoperation would end and Folsom would return to a seasonal 400,000 acre-feet fixed flood storage operation when the detention dam was completed.

West Sacramento Project

The West Sacramento Project would benefit from this plan. Since water would be temporarily stored behind the dam, instead of being discharged to the lower American River and to the Yolo Bypass, stages in the bypass would be slightly lower. That would tend to improve the reliability of the West Sacramento Project over the without-project condition.

Sacramento River Bank Protection Project

As with the previous plans, the Detention Dam Plan would be consistent with ongoing erosion control and bank erosion work on the Sacramento and American Rivers.

Sacramento and American Rivers Flood Control Projects

By controlling flows on the American to 115,000 cfs for a longer period of time, portions of the Sacramento River and Yolo Bypass levees would be more reliable with this plan than in the without-project condition. The American River Flood Control Project levees would be improved by the additional slurry wall under the Detention Dam Plan and continue to be operated for a maximum safe flow of 115,000 cfs.

Natomas Levee Construction Project

In combination with construction of the SAFCA local project, Natomas would be provided a very high level of flood protection with this plan.

Central Valley Project

The CVP would slightly benefit from this project because of the change in the operation of Folsom Reservoir. The impact of that change is discussed in the reoperation section of chapter VII.

PLAN ECONOMICS

The project economics are based on October 1995 price levels, 7⅝ percent interest rate, and 100-year period of analysis. Construction would last about 8 years beginning in 2000.

Costs

Estimated first and annual costs of the plan are summarized in table V-8. The total estimated first cost is $949 million, and the estimated average annual cost is $95 million.

Benefits

As shown in table V-9, the total average annual benefits are about $186 million. This includes flood control benefits (including flood damage reduction and traffic disruption benefits and resource replacement benefits) and bridge replacement benefits relating to the relocation of Highway 49 and Ponderosa Way.

Economic Justification

Overall Feasibility. As shown in table V-9, the estimated net annual benefits for this plan are $91 million and the benefit-cost ratio is 1.9 to 1.

Incremental Analysis. As with the Folsom Modification Plan, the levee stabilization work along the lower American River and the Natomas levee improvements can be considered as separable plan elements and as a last-added increment. These features are economically feasible as a last-added increment.

IMPLEMENTATION

Implementation of this plan will include construction of the physical features described above. It would be unlikely to result in a major extension of the temporary reoperation of Folsom Dam and Reservoir for increased flood control.

TABLE V-8

Detention Dam Plan - Cost Estimate [1]
($ million)

Item	Total Previously Expended Thru FY96	Detention Dam Area	Lower American River	Natomas Area	Total
First Cost					
Lands and management		45.2	2.0	1.5	48.7
Roads and relocations		104.3	0.0	0.0	104.3
Dam & reservoir		512.0	0.0	0.0	512.0
Levee modifications		0.0	31.1	9.3	40.4
Cultural resources		6.7	0.3	0.1	7.1
Environmental mitigation [2]		15.0	0.0	0.0	15.0
E, D, S, and A [3]	15.0	106.0	10.5	2.1	118.5
Subtotal	15.0	789.1	43.9	13.0	861.0
Creditable expenditures to date [4]	.0	87.7	0.0	0.0	87.7
Total	15.0	876.8	43.9	13.0	948.7
Investment Cost					
First Cost	15.0	876.8	43.9	13.0	948.7
Creditable expenditures to date [4]		-87.7	0.0	0.0	-87.7
Interest during construction [5]	19.9	303.6	29.3	11.2	364.0
Total	34.9	1092.7	73.2	24.2	1225.0
Annual Cost [6]					
Interest and amortization	2.7	83.4	5.6	1.8	93.5
Operation and maintenance	0.0	1.8	0.0	0.0	1.8
Total	2.7	85.2	5.6	1.8	95.3
Annual Benefits					185.8
Net Annual Benefits					90.5
Benefit-Cost Ratio					1.9

[1] October 1995 price levels.
[2] Does not include lands.
[3] Engineering, design, supervision, and administration.
[4] Included in cost apportionment but not economic analysis.
[5] Includes interest on construction expenditures until project year which is 2007.
[6] Investment cost with 100-year economic project life, and 7⅝ percent interest rate.

TABLE V-9

Economic Summary of Detention Dam Plan

Item	($ million)
First Cost	948.7
Annual Costs [1, 2]	95.3
Annual Benefits [2]	
Flood control	
Inundation reduction [3]	126.3
Benefits prior to base year	48.6
Bridge replacement	1.2
Resources gain	9.7
Total	185.8
Net Annual Benefits	90.5
Benefit-to-cost ratio	1.9

[1] Includes IDC.
[2] 100-year economic project life and 7⅝ percent interest rate.
[3] Inundation reduction benefits including future growth through project life.

The allocation of first costs for this plan is estimated at $711 million Federal and $232 million non-Federal. Table V-10 shows a breakdown of the allocation for this plan.

TABLE V-10

Detention Dam Plan - Cost Apportionment [1]
($ million)

Item	Federal	Non-Federal	Total
First Cost	776.3	172.4	948.7
Cash Adjustment	-64.8	64.8	
Total	711.5	237.2	948.7
Percent of First Cost	75	25	

[1] 1995 price levels.

CHAPTER VI

PLAN SELECTION

PLAN SELECTION CRITERIA

Four general criteria were used in formulating and evaluating the candidate plans. They include completeness, effectiveness, efficiency, and acceptability. Within the framework established by these four criteria are comparison factors leading to the recommendation of a selected plan. These criteria and factors relative to each of the candidate plans are described below.

COMPLETENESS

Completeness is the extent to which an alternative plan provides necessary investments or other actions to ensure realization of the planning objectives. Following is a description of completeness with respect to seven important comparison factors: (1) objectives, (2) consistency, (3) further action, (4) physical implementability, (5) water-related resources, (6) environmental resources, and (7) hydraulic conditions.

Objectives

Each of the candidate plans except the no-action alternative address the planning objective of flood control. The Stepped Release Plan also includes features to address recreation and environmental restoration needs along the lower American River. None of the plans address the need for additional water supply in the basin or power production in the region. However, the Detention Dam Plan would allow a return of flood control operations at Folsom Reservoir to conditions existing prior to the SAFCA/Reclamation reoperation agreement halting the water and power losses associated with reoperation. The Stepped Release Plan would not exacerbate impacts on CVP operations from without project conditions while the Folsom Modification Plan would increase the adverse impacts to water and power.

Consistency

This is the capability to consistently and reliably provide a specified degree of flood protection. Although there is some uncertainty in the ability to accurately project future hydrologic conditions in the watershed, each of the candidate plans would consistently provide the relative increases in flood protection levels that have been identified in this report.

Further Actions

Whichever plan is ultimately selected for implementation, it is expected that it will be constructed in total and over one time period. Accordingly, from a construction point of view, no further actions would be required other than normal operation and maintenance of project features to ensure fulfillment of the stated degree of flood protection and other project accomplishments. However, for those plans that include increasing the flood control storage space in Folsom Reservoir, there is a high uncertainty about the impacts to water supply, hydropower, recreation, and related reservoir resources. This uncertainty results from factors outside the control of the project operators, such as evolving standards for downstream water quality and operation of upstream reservoirs. Accordingly, the alternatives that include reoperation of Folsom Dam and Reservoir may require additional action over time to assess impacts and mitigation needs. In addition, since there would be a significantly lower level of flood protection provided with these two alternatives, there would be significantly greater actions required following major floods to restore areas in the flood plain impacted by these events.

Physical Implementability

Each of the action candidate plans have a similarly high capability of being implemented. None present unusually difficult construction challenges.

Water Related Resources

One factor in rating the completeness of a plan is in the ability to identify and mitigate unavoidable impacts to water, power, and recreation resources. The certainty is fairly low to accurately identify and mitigate impacts to water, power, recreation, and related reservoir resources in Folsom Reservoir and in the CVP and SWP. The Detention Dam Plan allows a return of Folsom to operation conditions prior to interim reoperation. Both the Stepped Release and Folsom Modification Plans would require features to insure the water, power, and recreation users are compensated for losses due to an increase in flood space in Folsom Reservoir.

Environmental Resources

The ability to mitigate unavoidable adverse environmental impacts is an important factor in completeness. The types of environmental impacts and scope of mitigation are fairly different for each alternative. However, the expected success is similar for the three plans in the ability to accurately identify potential direct impacts and the potential ability of the mitigation measures to offset the direct impacts.

Hydraulic Conditions

This is the ability to identify and mitigate unavoidable adverse hydraulic impacts to other areas; that is, not to induce flooding or not to increase the risk of flood damages in

adjacent areas. Both the Detention Dam and Folsom Modification Plans are superior to the Stepped Release Plan on the ability to reduce hydraulic impacts due to higher flows to areas downstream from American River. Even though, the Stepped Release Plan includes features to offset potential impacts, there would continue to be concerns about hydraulic impacts from downstream property owners.

EFFECTIVENESS

Effectiveness is the extent to which an alternative plan resolves the identified problems and achieves the planning objectives. Factors in measuring effectiveness include: (1) flood protection, (2) recreation opportunities, (3) environmental restoration, and (4) water and power. Because of the significantly higher level of flood protection provided, the Detention Dam Plan ranks higher than the other plans. The Stepped Release Plan also ranks higher because of the high level of flood protection and contribution to recreation and environmental restoration goals.

Flood Protection

Figure VI-1 illustrates the relative level of flood protection expected for the three plans. As shown, the flood protection provided by the three plans would range from 1 chance in 100 for the without-project condition to less than 1 chance in 500 of flooding for the Detention Dam Plan.

Given inherent uncertainty about predicting flows and stages for various events, included in Plate 10 is the expected performance of the three candidate plans for various storm events. For example, there is a 54, 68, and 97 percent chance of passing the 200-year storm without levee failure under the Folsom Modification, Stepped Release, and Detention Dam Plans, respectively.

Recreation and Environmental Restoration

Only the Stepped Release Plan includes features to increase recreation and environmental restoration conditions in the American River basin. This is primarily because this offers the opportunity to effectively include these features due to the significant structural work in the lower American River.

Water and Power

None of the alternative plans address the need for increased water and power resources in the study area. The detention dam plans would eliminate adverse impacts associated with the without-project condition reoperation. Alternatives including reoperation of Folsom Dam and Reservoir would adversely affect existing water and power resources. However, the Folsom Modification and Stepped Release Plans and to include features to offset potential adverse impacts on existing resources.

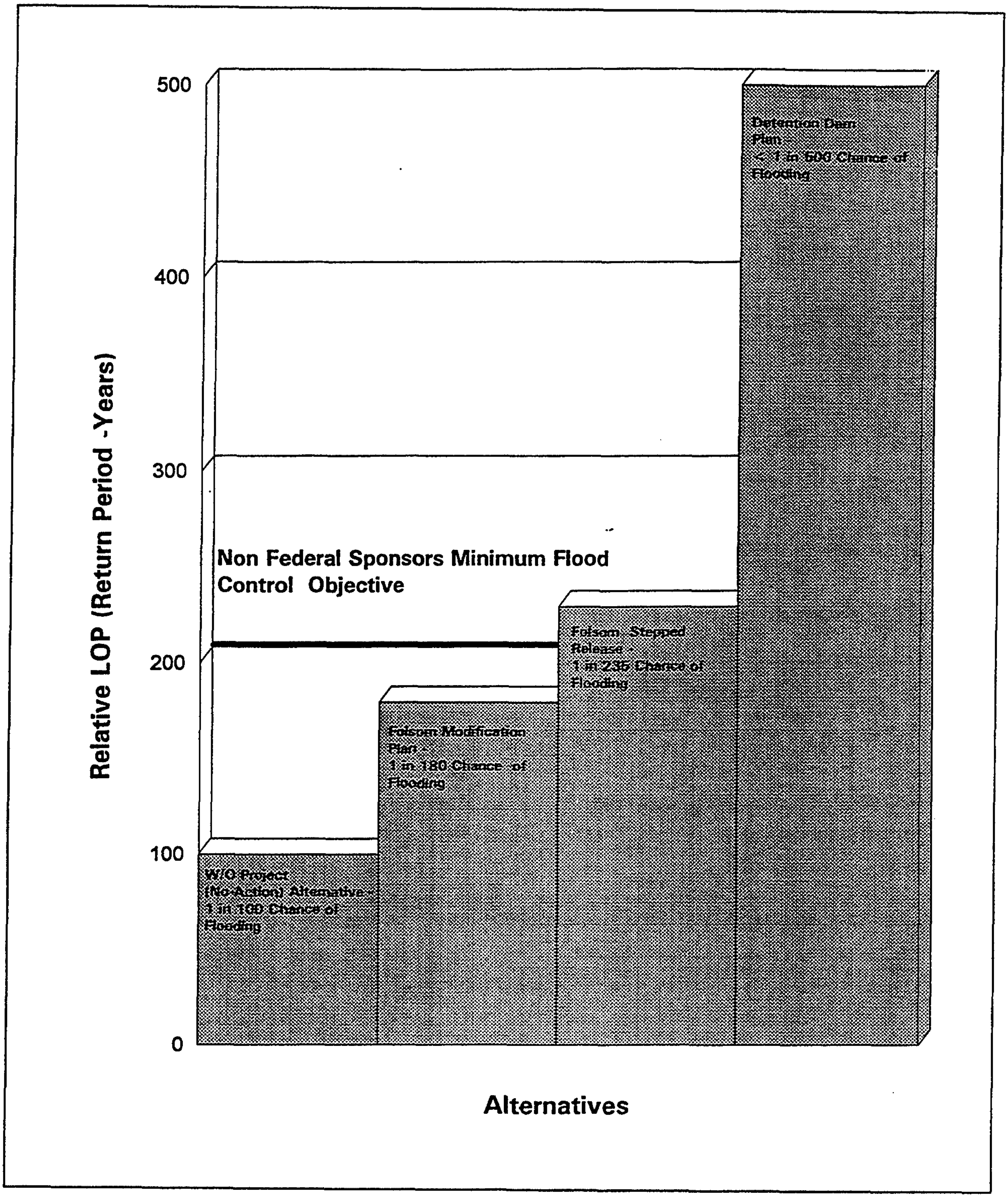


Figure VI-1. Relative level of protection (LOP) in years (estimated exceedence return period) for the no-action alternative and the three candidate plans. (A 235-year level of protection, for instance, has a 1 in 235 chance of flooding in any year.)

EFFICIENCY

Efficiency is a measure of the extent to which an alternative is the most cost-effective means of alleviating the identified problems while realizing the specified objectives, consistent with protecting the Nation's environment. One measure of efficiency is monetary costs versus benefits. Efficiency is displayed as net economic benefits and is the extent that the economic benefits exceed costs.

Net benefits for each of the three plans are displayed in table VI-1. As shown, annual net flood control benefits range from a high of approximately $91 million for the Detention Dam Plan, to $54 million for the Folsom Modification Plan and $38 million for the Stepped Release Plan. It is important to note that even though each plan produces net economic benefits, several major increments of the Stepped Release Plan are not economically feasible as a last-added increment.

Another measure of efficiency is the extent to which each alternative reduces flood damages. Table VI-2 shows for each alternative the estimated average annual equivalent flood damages, resulting economic benefits, and percent reduction in flood damages under existing and without-project conditions. For example, the table shows that the Detention Dam Plan would result in an annual equivalent residual flood threat in Sacramento amounting to about $29 million under 1995 conditions, which represents an 80 percent reduction in damages from the without-project condition. The action plan providing the lowest level of flood protection, Increase Folsom Flood Space, would reduce average annual damages by just 42 percent.

ACCEPTABILITY

Acceptability is the workability and viability of an alternative to other Federal agencies, affected State and local agencies, and public entities, given existing laws, regulations, and public policies. Support by a non-Federal sponsor is of prime importance in this category. The relative acceptability of the three candidate plans was judged on the basis of the public review of the draft Supplemental Information Report in late summer 1995.

Non-Federal participation in the project is essential because the non-Federal sponsor must share in the cost of construction and provide long-term maintenance and operation. Without this participation, it would not be possible to proceed with the project. The willingness and capability of the non-Federal sponsor to share the project cost is a major factor in determining a plan's acceptability.

Both the Reclamation Board and SAFCA held a series of joint public open houses and hearings focusing on the three candidate plans during the September through November 1995 period. On the basis of staff recommendations and the outcome of those hearings, both entities recommended in resolutions dated October 12, 1995 and November 9,1995, that the Detention Dam Plan be selected for recommended implementation.

TABLE VI-1

Summary Comparison of No Action and Candidate Plans

Item	Alternative			
	No-Action Alternative	Folsom Modification Plan	Folsom Stepped Release Plan	Detention Dam Plan
Level of flood protection (probability of flooding in any one year)	1 in 100	1 in 180	1 in 235	less than 1 in 500
Reduction in flood protection (%)	-	43	49	79
Probability of passing a 200-year storm (%)	16	54	68	97
Features				
Folsom Dam & Reservoir				
Flood control space (ac-ft)	400,000/670,000	475,000/720,000	400,000/670,000	400,000
Maximum objective release (cfs)	115,000	115,000	145,000/180,000	115,000
Lower main spillway 15 feet	No	Yes	Yes	No
Outlets (No. of gates & capacity, cfs)	8 at 30,000	8 at 70,000	8 at 70,000	8 at 30,000
Modify surcharge storage	No	Yes	Yes	No
Lower American River				
Stabilize/modify levees (mi)	0	24	29	24
Raise/replace bridges	0	0	3	0
Recreation trails & park areas (acres)	0	0	13	0
Environmental restoration areas (acres)	0	0	103	0
Downstream American River				
Modify Sacramento River levees (mi)	0	12	12	12
Modify Sacramento Weir & Bypass (ft)	0	0	1,000	0
Modify Yolo Bypass levees (mi)	0	0	52	0
Upstream Storage				
Detention space (ac-ft)	0	0	0	894,000
Dam height (ft)	0	0	0	508
Flood operation gates	0	0	0	20
Bridge relocations	0	0	0	2
Benefit Comparison - Without-Project Condition (with Folsom reoperation to 400,000/670,000) [1]				
Costs ($ million)				
First cost	-	399	521	949
Annual cost	-	44	65	95
Annual benefits ($ million)	-	98	101	186
Net annual benefits ($ million)	-	54	36	91
Benefit Comparison - Baseline Condition (before reoperation) [2]				
Cost ($ million) [3]				
First cost	-	469	627	949
Annual cost	-	49	73	95
Annual benefit ($ million) [3]	-	126	129	206
Net annual benefits ($ million) [3]	-	77	56	111

[1] The current reoperation of Folsom Dam and Reservoir would continue indefinitely under the No-Action Alternative (without-project condition) and so are assumed to also continue with both the Folsom Modification and Folsom Stepped Release Plans associated with this reoperation level are being paid by SAFCA, so they are not included in this table.

[2] Includes costs and benefits associated with adopting permanent reoperation in Folsom Modification and Stepped Release Plans.

[3] Increase from without-project condition reflects costs and additional permanent reoperation of Folsom from 400,000 acre-feet to 400,000/670,000 acre-feet.

TABLE VI-2

Comparison of Flood Damages Reduction [1]

Alternative	No Action	Folsom Modification Plan	Folsom Stepped Release Plan	Detention Dam Plan
Flood Protection (chance of flooding in any year)	1 in 100	1 in 180	1 in 235	<1 in 500
Annual Flood Damages ($ million)				
Baseline [2]	170	170	170	170
Without-project conditions [3]	142	142	142	142
With-project conditions [4]	142	82	73	29
Percent reduction from baseline conditions	16	52	57	83
Percent reduction from without-project conditions	--	42	49	80

[1] 1995 price levels, 7⅝ percent discount rate, and 100-year period of analysis. Based on 1995 conditions with no damages for future planned growth.
[2] Natomas levee construction completed, no reoperation of Folsom.
[3] Reoperation of Folsom Dam and Reservoir.
[4] Residual damages with implementation of alternative.

At the public meetings mentioned above, much testimony was received on flood protection for Sacramento. Testimony ranged from support for or opposition to one or more of the alternative plans to requests that the alternatives include other features such as water supply and additional recreation and environmental restoration. There was a very strong and vocal contingent of individuals and organizations expressing concerns about construction of dam on the North Fork American River.

SUMMARY

Table VI-3 includes an indication of the overall relative ranking of each of the initial array of candidate plans. The Stepped Release Plan and the Detention Dam Plan were generally ranked higher than the Folsom Modification Plan. The Detention dam Plan would significantly reduce flood damages, would alleviate the need for reoperating Folsom, and is tentatively supported by the non-Federal sponsors. Even though it has incrementally infeasible increments, the Stepped Release Plan would also provide a high level of protection and has strong non-Federal support.

TABLE VI-3

Summary Comparison of Candidate Plans

Plan	Plan Formulation Criteria				Relative Ranking
	Completeness	Effectiveness	Efficiency	Acceptability	
Detention Dam	Addresses one or more planning objectives. Technically implementable with a high probability of consistently providing stated increase in protection without further actions. Improves existing water resources problems by eliminating need for reoperation and fully mitigates for environmental damages. No hydraulic mitigation required.	High level of flood protection. Does not meet incidental recreation or environmental enhancement goals. Improves water supply & hydropower capability of CVP by eliminating need for reoperation.	Very high net economic benefits. Large reduction in residual flood threat.	Identified by non-Federal project as plan for recommended implementation. Residual concerns about potential impacts in the American River canyon.	Very High
Relative Rank	Very High	High	Very High	High	
Stepped Release	Addresses one or more planning objectives. Can consistently provide stated increase in flood protection and is technically implementable. Future actions may be required to reanalyze and fully compensate for impacts to water, power, and recreation at Folsom, as well as to environmental values in the American River. Requires hydraulic mitigation to compensate for impacts to other areas.	High level of flood protection. Positive contribution to recreation and environmental restoration.	High net economic benefits, but includes uneconomical increments.	Satisfies non-Federal flood control agencies' minimum flood control goal. Although not the locally preferred plan, it has significant support among environmental groups and individuals.	High
Relative Rank	High	Very High	Moderate	Low	
Folsom Modification	Same as Stepped Release Plan, but does not include features to address recreation and environmental restoration objectives.	Provides only a moderate increase in flood protection. Does not meet incidental recreation or environmental enhancement goals, and would have adverse impacts on water and power systems.	Moderate net economic benefits. Moderate reduction in flood damages.	Does not meet non-Federal flood control agencies' minimum flood control goal. Little interest by non-Federal sponsors. Has significant support among environmental groups and individuals.	Moderate/High
Relative Rank	High	Moderate	High	Low	

Overall, each of the alternative plans is complete. As table VI-3 shows, the Detention Dam Plan and the Folsom Modification Plan tend to rate higher than the other alternatives, primarily because no significant future actions would be required to quantify and mitigate impacts associated with (1) changes to the CVP and SWP as a result of Folsom reoperation and (2) increased floodflows to the Sacramento River and Yolo Bypass.

Table VI-1 summaries the accomplishments, features, and costs and benefits of the three candidate plans. Figure VI-1 illustrates the level of flood protection expected for the candidate plans. As the table shows, the first cost for the Detention Dam Plan is considerably greater than the two other plans. However, the plan also provides the greatest increase in protection to Sacramento.

PLAN SELECTION

Plan selection was based on all of the above criteria. The flood Detention Dam Plan is rated highest overall based upon the four evaluation criteria (economic efficiency, public health and safety, and environmental categories). Both the Reclamation Board and SAFCA, identified this plan as the locally preferred plan. On the basis of these recommendations, this alternative was identified as the Selected Plan for submittal to Congress.

CHAPTER VII

SPECIAL TOPICS

This chapter discusses five special topics: (1) Folsom Reservoir flood space modifications, (2) Federal participation in Folsom Dam and Reservoir reoperation, (3) transfer of flood control storage space from Folsom Reservoir, (4) gating and expandability issues for a detention dam, and (5) seismic issues.

FOLSOM RESERVOIR FLOOD SPACE MODIFICATIONS

Any change to the flood control space in Folsom Reservoir could affect other beneficial uses of Folsom Dam and Reservoir, including water supply and hydropower. This section (1) highlights future water demands in the study area, (2) describes modeling methods used to assess impacts to water and power resources due to increasing or decreasing the seasonal flood control storage space in Folsom, (3) summarizes potential impacts on water and power resources, and (4) outlines potential measures to mitigate reductions in water and power resources. The environmental impacts from the increased flood space are discussed in the SEIS/SEIR. Detailed descriptions of the four subjects listed above are contained in "American and Sacramento Rivers Project, Task 4: Folsom Dam and Reservoir Permanent Reoperation," by the consulting firm of Montgomery Watson Americas, Inc.

SUMMARY OF WATER NEEDS

The population of California is expected to increase by about 75 percent, or to nearly 60 million, by the year 2030. Much of this increase will occur in the central and northern portions of the State. In the five-county area of El Dorado, Placer, Sacramento, San Joaquin, and Sutter, this increase is expected to be significantly greater. The current population of about 2 million in this area is projected to increase to about 3.8 million by 2030, or by 90 percent.

The additional population will place demands on existing water supplies, especially for M&I (municipal and industrial) uses. As table VII-1 shows, the 1990 total water demand in the five-county area was about 2.7 million acre-feet. By 2030 this demand is expected to increase to approximately 3 million acre-feet per year. Demands for agricultural uses will fall by about 250,000 acre-feet per year as a result of water conservation measures, taking marginal lands out of production, or converting some lands to urban uses. Demands for

TABLE VII-I

American River Watershed and Vicinity - Water Needs (2030)
(1,000 acre-feet per year)

County	Water Demands						2030 Supply			Unmet Need
	1990			2030						
	Agricultural	M&I[1]	Total	Changes Agricultural	Increase M&I	Total	Surface Water	Ground Water	Total	
El Dorado	19.2	26.9	46.1	0.8	38.4	85.3	48.2	0	48.2	37.1
Placer	245.9	99.3	345.2	-17.7	65.4	392.9	190.4	124.6	315.0	77.9
Sacramento	361.5	390.1	751.6	-79.9	305.5	977.2	326.7	476.0	802.7	174.5
San Joaquin	1120.7	111.3	1232.0	-109.5	125.6	1248.1	500.6	617.9	1118.5	129.6
Sutter	307.8	0.9	308.7	-54.5	26.1	280.3	124.7	119.6	244.3	36.0
Delta Salinity 1			70.0			70.0			0	70.0
Total	2055.1	628.5	2753.6	-260.8	561.0	3053.8	1190.6	1338.1	2528.7	525.1

[1] M&I = municipal and industrial.
Source: U.S. Bureau of Reclamation, American River Water Resources Investigation, spring 1995.

M&I uses, however, are expected to increase by more than 500,000 acre-feet per year, even after reductions associated with water conservation measures.

As supplies are today, future water supplies will be provided from a combination of surface- and ground-water sources (table VII-1). Total future supplies are estimated to be about 2.5 million acre-feet.

The estimated future (2030) unmet need amounts to more than 500,000 acre-feet per year in the five-county area. This growing unmet need for additional supplies will exist throughout the CVP and SWP (State Water Project) service areas. Because of this increasing unmet demand for water, any decrease in the capability of the existing system to deliver existing water supplies will add to the expected future net demand for water.

PROSIM COMPUTER MODEL

The PROSIM (PROject SIMulation) model was used to evaluate the impacts of modifying the flood control space in Folsom Reservoir. The model was developed by Reclamation to evaluate the effects of operating the CVP/SWP under various hydrologic conditions. The model takes into account storage in the various reservoirs; water demands for a variety of needs at various locations, including minimum flow standards; and basic hydrologic parameters under various water year conditions. Basic "outputs" from the model include end-of-period reservoir storage, deliveries to users, and streamflows at various points. From this information, estimates of water deliveries, reservoir storage, hydropower capacities, and water temperatures can be developed for a variety of different conditions. The PROSIM model simulates conditions by the mass balance approach on a monthly time step over a specific data period—in this case 70 years (1922 through 1991).

Important input assumptions used in the model include hydrology and a host of system constraints. Hydrology includes recorded and simulated gains (inflows) or losses (evaporation, for example) to system reservoirs and gains or losses to the streams. It also includes system demands under current and future (2020) conditions. Several important system constraints are:

- State Water Resources Control Board Delta standards
- State and Federal Coordinated Operations Agreement
- Endangered Species Act biological opinions
- Clean Water Act and EPA Delta standards
- Central Valley Project Improvement Act requirements
- Other criteria including minimum flows for the American, Feather, and Trinity Rivers

Studies show that, generally, assumptions made about these constraints significantly influence the outcome of the PROSIM simulations. However, they also show that regardless of the assumptions made, they do not significantly change the indicated relative impacts of increasing the flood control storage space in Folsom Dam and Reservoir. As an example,

the relative reduction in CVP delivery caused by the EPA standards in comparison with winter-run salmon requirements would amount to about 560,000 acre-feet per year, which is about 6 percent of the total system delivery. However, the maximum relative impact of any of the Folsom Reservoir operation changes evaluated in this study amounted to less than 10,000 acre-feet per year, which is significantly less than 1 percent. Accordingly, the relative results achieved are generally insensitive to assumptions on future water demands, endangered species, or EPA standards.

OPERATION SCENARIOS

To estimate the impacts of the various alternatives for flood control on water and power supplies, model simulations were accomplished for three basic scenarios:

400 Fixed to 400/670. This scenario was used to assess the long-term impacts associated with permanent reoperation from the authorized (prereoperation, or baseline, condition) fixed flood control space of 400,000 (400 fixed) acre-feet to a variable space of between 400,000 and 670,000 (400/670) acre-feet. This scenario is important in assessing the long-term impacts and costs associated with the Stepped Release Plan and for determining the extent of potential Federal participation in the permanent reoperation element of that plan. The scenario is also important in assessing the economic and related benefits of the Detention Dam Plan, which would result in relieving the need for continued reoperation of Folsom Reservoir as defined in the without-project condition.

400/670 to 475/670. This scenario includes assessing impacts of increasing the flood control storage space in Folsom Reservoir from a variable space between 400,000 and 670,000 (400/670) acre-feet to a space of 475,000 and 670,000 (475/670). Model studies indicate that the majority of the impacts of reoperation are caused by the change in the minimum required space. The need to increase the required space above the minimum is fairly infrequent. For that reason, the results of the 475/670-acre-foot operation simulations are considered to be equivalent to the 475/720 operation, which is part of the Folsom Modification Plan.

400 Fixed to 475/720. Concern was expressed by resources agencies that the potential for impacts associated with increasing the flood space in Folsom Reservoir first from 400 to 400/670 (reoperation) and then to 475/720 (see above) might be significantly different than the impacts of 400 to 475/720. Accordingly, this scenario was evaluated to assess this potential difference.

MAJOR WATER, POWER, AND RELATED IMPACTS

Water Supply

Increasing the amount of flood storage in Folsom would (1) on net, reduce the amount of water the CVP/SWP system can deliver and (2) reduce the overall ability the system has to deliver water. On average, the impacts would be relatively small compared to the total delivery of the CVP and SWP. In many years there would be little or no adverse impact because the system can refill following the winter drawdown period. Modeling studies indicate that in some years the greater space requirement in Folsom Reservoir would actually result in an increase in available supplies. However, in other years the system cannot completely recover due to reduced inflows, and resulting adverse impacts would be sizable.

Table VII-2 shows the estimated impacts of the three scenarios on water delivery. Water delivery is characterized in the table as (1) indicated delivery and (2) equivalent delivery. Indicated delivery is obtained directly from the PROSIM as changes in supplies to water users. Equivalent delivery is water that could have been delivered under the alternative being evaluated, but shows up in the model as changes in overall storage of the system. The average annual cumulative change in the net storage represents the estimated effects of each scenario on the ability of the system to deliver water.

It is important to note that whether or not impacts of reoperation are evaluated on the basis of minimizing delivery changes (maximizing storage changes) or minimizing storage changes in PROSIM model runs, in the final analysis they are both reductions or increases in the system's ability to deliver water. Accordingly, for economic comparison purposes, the total estimated impact on water delivery is the sum of the indicated and equivalent delivery. However, for the environmental analysis for this study, impacts and mitigation were assessed on the basis of relative changes in riverflows and reservoir storages as indicated by the PROSIM model. A primary assumption in the model was that riverflows would be held, to the extent possible, similar for the various scenarios. Accordingly, major impacts show up as changes in reservoir storage. Had the PROSIM model analysis been made holding reservoir storages constant, the major impacts would have been manifested as changes in riverflows. The environmental analysis would have yielded different results. Again, however, in either case the impact on the CVP/SWP ability to delivery water would be similar.

It is important to note in table VII-2 that a plus (+) indicates, on an annual equivalent basis, the volume of water that would be available for sale or surplus due to the alternative. This water would have a relatively low economic value because it would be made available during periods when there were excesses of overall supply. A minus (-) in the table is the annual reduction in equivalent yield, similar to reductions in firm yield. This is water that would need to be purchased, or restored, and represents a cost to the alternative operation scenario. This water would have a high value since it would be required during water-short periods. Figure VII-1 shows the progression in estimating total excess or deficient equivalent delivery for the 400/670 to 475/720 scenario.

TABLE VII-2

Water and Power Impact [1]

Item	Reoperation Scenario		
	400 to 400/670	400/670 to 475/720	400 to 475/720
Water Delivery [1] (1,000 ac-ft/yr)			
Indicated delivery	0	+11 and -4	+11 and -4
Equivalent delivery [2]	+5 and -14	+11 and -31	+12 and -38
Total	+5 and -14	+22 and -35	+23 and - 42
Power			
Energy (GWh/yr)	-12	-6	-18
Capacity [3] (MW/mo)	-4	-12	-16
Local Pumping (Gwh/yr)	-0.1	-0.3	-0.4

[1] Based on year 2020 demands and 70-year period of analysis.
[2] Equivalent delivery related to reservoir storage and is a measure of the ability to deliver water. The average annual potential delivery change due to storage change can be positive—(when storage is improved by reoperation) or negative (when storage is reduced by reoperation).
[3] Average seasonal maximum reduction in capacity. Average is about one0fourth this amount.

Information in table VII-2 are the impacts on an average annual basis, however, the impacts vary from year to year as shown on figure VII-1.

Power

Lower water surfaces in the reservoirs and changes in the release schedule of the CVP/SWP translate into less system ability to generate energy and reduced overall capacity. The greatest hydropower impacts though, usually occur in a wet winter when other local hydropower may be available. Summer capacity reductions are smaller and infrequent. Energy and capacity impacts could be evaluated in several ways. One way would be to average the annual impact including both losses and gains due to reoperation. Another way would be to calculate impacts using annual maximum losses to the system. For this study, the impact on energy generation was calculated on an average annual basis as it would be relatively easy to replace. Capacity—the instantaneous power output of the system—would be more difficult to replace and was calculated as the average annual maximum impact.

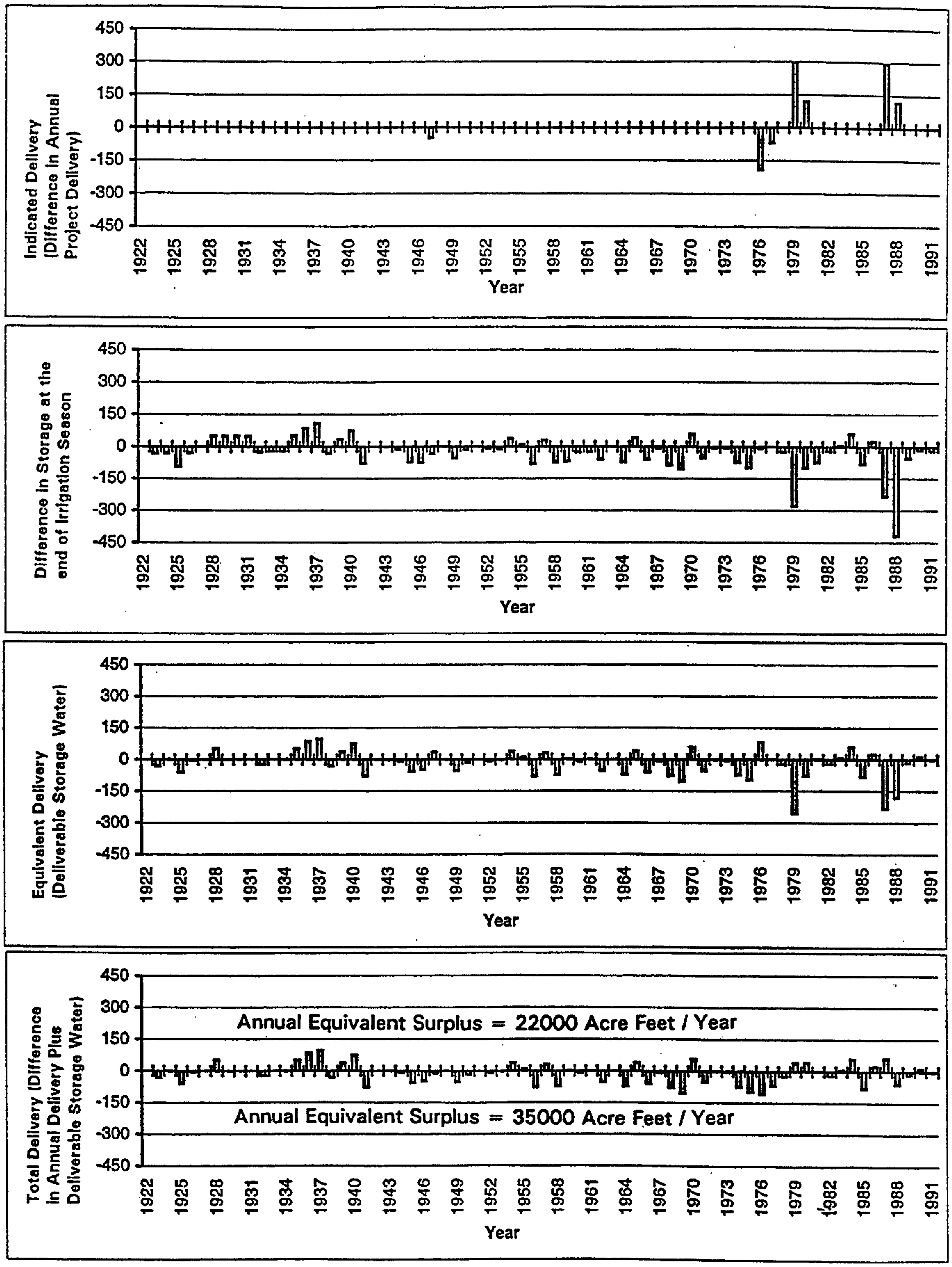


Figure VII-1 Development of estimated changes in total delivery impacts To CVP/SWP resulting from changing the flood control Operation from a flexible space of 400/600 TAF to 475/720 TAF including December 1994 Bay Delta Standards and Year 2020 demands.

Source: Montgomery Watson Consulting Engineers, May/June 1995

Table VII-2 includes estimates of the reduction in the energy and capacity of the CVP/SWP system for the three scenarios. More information on the hydropower impacts is contained in the Montgomery Watson reoperation report, February, 1996.

Local Water Pumping

The lower water surfaces in Folsom Reservoir would affect local water users because more pumping energy would be required to deliver water. Lower lake levels that would occasionally occur due to reoperation would not affect water quality. Table VII-2 includes estimates of the increased pumping requirements of the local water users for the three scenarios on an average annual basis. The greatest impacts on pumping energy (up to four times the average energy) would be in winter in a the rare year when the reservoir would be severely drawn down for flood control due to wet upstream conditions. The quantity of water available for local users however would not usually be affected by reoperation. Local water supply availability is affected by extremely low reservoir levels caused by droughts and during these periods, drawdown for flood control is not necessary. Only when a large flood control drawdown is followed by dry years, such as in 1976 and 1977 does reoperation contribute to low reservoir levels.

Extremes in Reoperation

The long-term average impacts of Folsom reoperation are relatively small, however as can be seen in the Figure VII-1, certain hydrologic conditions can produce significant impacts in unusual years. To describe a significant reoperation event we have chosen to discuss the impacts that would be associated with 1976 and 1977, the greatest water delivery impact years during the 70-year hydrologic record. It is also the critical drought event where the impacts of reoperation could have an effect on the California's water supply and environment.

In the simulation of the 475/720,000 acre-foot variable reoperation, 1975 resulted in drawdown of Folsom Reservoir for flood control. 1976 was a dry year that did not refill Folsom so the reoperation deficiency carried over from 1975 to 1976. Shifting some of the demands to Shasta started to reduce the reoperation impact carried over from 1975. However, delivery shortages of up to 100,000 acre-feet could occur if not replaced. The next year 1977 was a critical dry year again did not refill Folsom resulting in very low water levels—primarily due to the drought instead of the reoperation drawdown.

The significant impacts of this reoperaton event would be that local water supply could be reduced by up to 20 percent if the mitigation plan to replace water were not implemented. (This impact would be due to the 475/720 plan, the 400/670 plan does not affect Folsom critical year supply.) However, the mitigation plan discussed in this chapter, reduces the water demands on Folsom so that prereoperation lake levels could be recovered by the end of the water year. Hydropower impacts would be about 11 MW, and 8 GWh in 1976. There would also be small environmental impacts due to reduced lower American

River and Sacramento River flows. These extreme year impacts are further discussed in the Montgomery Watson Reoperation Report, May 1995.

POTENTIAL MITIGATION

Water Supply

Offsetting, or mitigating, the impacts of reduced deliveries or delivery capability of the CVP/SWP could be accomplished in several ways. One would be to construct a new water project sized to provide a yield to replace the average annual equivalent delivery lost. Using traditional critical dry period analysis to estimate project size (project sized to replace the firm yield forgone by reoperating, which is similar to the negative impacts on delivery in table VII-2) would require a reservoir on the order of about 100,000 acre-feet for the 400 fixed to 400/670 variable operation scenario and nearly 300,000 acre-feet for the 400 to 475/720 scenario. Such projects would be extremely costly and very difficult to implement in the current institutional environment. Depending on the type, size, and location of the replacement project, unit costs could range from about $250 to over $1,000 per acre-foot.

Another way to mitigate the reduction in supply, would be to make a one-time payment to the CVP. That one-time payment could be used to improve the CVP through projects such as water supply augmentation, water conservation projects or environmental restoration projects as part of the CVPIA. These types of improvements would benefit the water infrastructure, water users and the environment, indirectly offsetting the negative impacts of reoperation.

Another approach to mitigate for reductions in water supply would be to permanently reduce the need for water equal to the average reduction. One way to accomplish this would be by taking agricultural lands out of production either though acquisition or through agreements with individual landowners. Taking lands out of production either permanently or periodically would likely require obtaining an interest in existing water rights in an amount equal to the estimated water loss, to ensure that the mitigation goal would be accomplished. Although no reliable estimates are currently available, on the basis of purchases of water rights in other areas, and given the expected significant future deficiencies in available supplies, this method could result in a unit value in excess of $200 per acre-foot. This value does not include, however, other economic "disbenefits" associated with reducing goods and services that would have been guaranteed had the water been used for its original purpose. This method also would over compensate in years when reoperation impacts are small or zero and would under compensate in big reoperation impact years.

Another method would be to replace water when delivery or storage reductions occur due to reoperation. Potential sources for the water would be the California water bank or other similar arrangement set up for for this reoperation water replacement. By reducing the demand on CVP reservoirs, water storage could be restored to "normal", or prereoperation levels. The water bank concept involves buying surface water from agricultural owners who

would temporarily increase ground-water pumping to make up the loss. This is only permissible in areas where ground-water overdraft is not occurring. Should temporary conversion to groundwater not available in sufficient quantities, then water conservation, changing cropping types, or fallowing may be required. All of these arrangements would have to be in place so they could be implemented when reoperation impacts occur.

The approach used in this analysis to estimate the economic cost of increased flood space and to assess environmental impacts was that the project sponsor would develop agreements with certain water contractors of the CVP to allow delivery reductions to occur due to reoperation. That would give Reclamation the ability to reduce demands on reservoirs and replace the water when deficiencies occur. The recent market price for water purchases through the water bank or water transfers has ranged from $130 to $180 per acre-foot, depending on water year conditions. In the future, however, with growing deficiencies in the ability to meet water demands, even with a significant increased reliance on ground-water resources, unit costs for water from the water bank (assuming it is available) would be significantly greater. Accordingly, a value of $300 per acre-foot was used in this analysis as the marginal replacement cost for the total water delivery reduction in table VII-2. For periods when an increase in supply is indicated, the value of this surplus water was estimated at 50 percent of the purchase price. Based on these unit values for water purchase and sale, table VII-3 shows estimates of the average annual equivalent water cost for the three scenarios. For a more through discussion of the mitigation plan, refer to the reoperation report by Montgomery Watson, May 1995. That report contains information on potential areas for obtaining mitigation water through delivery reductions, and environmental and socioeconomic impacts of such a plan.

The scenario described above was used to develop the cost of completely mitigting the impacts of reoperation by replacing not only reductions in delivery but also storage impacts. This mitigation method would require detailed recordkeeping to keep track of the impacts of the reoperated reservoir versus the nonreoperated condition. It would also take a significant administrative effort to obtain water from users even when the agreements were in place. The cost of the mitigation plan might be different if another water supply mitigation plan were chosen—such as those outlined in Reclamation's ongoing Yield Augmentation Study, part of CVPIA. The figures below could vary significantly if an alternative water mitigation plan were implemented.

Power

Mitigation for reductions in CVP system power and capacity would include reimbursement to WAPA (Western Area Power Administration). For the increased requirement in pumping for local Folsom water users, mitigation would be similar—payment for additional power. This payment could be on a one time basis for estimated impacts or calculated yearly. WAPA would purchase more power from outside sources and/or receive less income from power sales as a result of reoperation. Compared to the overall system, power and capacity impacts are small enough that replacement power would be available for purchase.

TABLE VI-3

Summary of Annual Costs
($1,000)

Item	Scenarios		
	400 to 400/670	400/670 to 475/720	400 to 475/720
Water Delivery	3450	7,200[1]	9150
Power (Generation and capacity)	1150	1300	2450
Local Pumping	10	30	40
Total	4610	8530	11640

[1] Example = $300 x 35,000 acre-feet/year - $150 x 22,000 acre-feet/year. (See table VII-2.)

In order to project electric power rates for the life of the project, Western Area Power Administration (WAPA) was requested to assist. Using their procedures for projecting future rates for planning purposes, WAPA assumed that power replacement would be by a gas turbine operating at a 30 percent plant factor. The levelized 100-year rate was determined to be $72,000 per GWh and $6,000 per MW month.

These costs were then applied to the hydropower impacts in table VII-2 to develop the costs in table VII-3. For this analysis, a single rate was used as opposed to a seasonally variable rate structure. Cost estimates for selected years were developed with both variable and single rate and the two procedures produced similar results. For more information on hydropower, see the Montgomery Watson Reoperation Report, February 1996.

FEDERAL PARTICIPATION IN FOLSOM DAM AND RESERVOIR REOPERATION

GENERAL

A basic without-project condition for this report is that the probability of flooding in areas along the American River will be reduced to about 1 chance in 100 in the future by the SAFCA/Reclamation reoperation agreement. Should the Folsom Modification Plan or the Stepped Release Plan be selected for implementation, SAFCA has requested that

(1) reoperation to the variable 400,000/670,000 acre-feet of flood control space be adopted as permanent operation criteria and (2) the cost associated with reoperation be shared with the Federal Government in accordance with other features of the selected plan. This section summarizes impacts, mitigation, and costs of permanent reoperation of Folsom Dam and Reservoir.

FLOOD CONTROL ACCOMPLISHMENTS

Under authorized (prereoperation) conditions, Folsom Dam and Reservoir together with the downstream levee system provide protection from flooding due to levee failure to Sacramento with a probability of 1 chance in 80 for any given year. With reoperation of Folsom to the 400,000 to 670,000 acre-feet of variable space, the threat of flooding to Sacramento is decreased to about 1 chance in 100. As shown in table VII-4, the average annual flood control benefits of reoperation amount to about $28 million.

COSTS

The primary costs of reoperating Folsom from the baseline (prereoperation) condition are for features to mitigate adverse impacts to CVP water supply and hydropower, recreation and related activities in and around Folsom Reservoir, and cultural and environmental resources. Potential impacts and mitigation features agreed on by Reclamation and SAFCA for interim reoperation are described in the EIR/EA on Interim Reoperation of Folsom Dam and Reservoir, finalized by the two agencies in December 1994. Impacts associated with permanent reoperation are described in the SEIS/SEIR (part 2 of this report). A summary of the potential impacts and mitigation features follows.

Water Supply, Hydropower, and Local Water Pumping

Table VII-2 includes impacts of reoperation from 400 fixed to 400/670 on (1) water supplies to the CVP/SWP system, (2) power reductions to the CVP, and (3) increased power costs to local Folsom Lake water users. The equivalent combined first cost of these impacts is estimated to be $59.4 million.

Recreation

More often than not, reoperation would not affect water levels in Folsom Reservoir during the recreation season. However, because the lake would be drawn down lower in some years than it otherwise would have been, boaters would have less access to the lake. The primary feature to mitigate the loss of an indeterminable number of recreation visitor days at Folsom would be to extend boat ramps. This would have a first cost of about $400,000.

TABLE VII-4

Benefits and Costs for Permanent Reoperation (400,000/670,000 acre-feet) of Folsom Dam and Reservoir

Item	$ Million
Annual Flood Damages	
Baseline (prereoperation) [1]	170
Without project (reoperation)	-142
Benefits[1]	28
First Cost	
Water supply replacement [2]	77.8
Hydropower replacement	26.3
Local pumping - power replacement	0.2
Recreation - boat ramp extension	0.4
Cultural resources - research program	0.2
Fisheries - outlet shutters modification	0.4
Total	105.3
Annual Costs (interest and amortization)	8.0
Net Flood Control Benefits (annual)	20.00

[1] Baseline (prereoperation) represents flood damages without any future growth in flood plains. Actually, some growth would occur, so indicated benefits would likely be somewhat greater.

[2] Example = $3.45 million (table VII-3) x 13.11 (present worth value, 100 year at 7⅝ percent interest rate) + $3.45 million x 9 years of reoperation during construction + $1.5 million in implementation costs.

Cultural Resources

Because of the potential for periodic lower water surfaces, additional cultural resources in the reservoir area would be subject to loss or damage. Identified mitigation for this impact includes funding a research program to update past cultural resource surveys for the reservoir. The cost of this program would be $200,000.

Fisheries

There is some potential for a periodic increase in the temperature of water released from Folsom Dam due to the reduction in water-surface elevation. In addition, during

certain critical fish-spawning periods, the release rate to the lower river could be reduced. The increased temperature and reduced flows would adversely affect downstream anadromous fishery resources. To mitigate these potential impacts, modifications to the release shutters in the outlet works at Folsom are planned. The estimated cost to modify the shutters is $400,000.

INCREMENTAL FEASIBILITY

As table VII-4 shows, the total estimated first cost of reoperation of Folsom Dam and Reservoir is about $60 million and the estimated annual cost is about $5 million. The equivalent average annual flood damage reduction benefits are about $28 million. Accordingly, reoperation is highly cost effective with a net annual benefit of about $23 million.

IMPLEMENTATION

Should the Stepped Release Plan or Folsom Modification Plan be authorized, implementation would include establishing mitigation for the impacts of permanent reoperation as discussed in this chapter. Currently, SAFCA is responsible for mitigating impacts of interim reoperation, but as part of the Federal project, permanent reoperation would become a cost shared item. Interim reoperation would continue until permanent reoperation was accomplished in the fourth year of construction of the project. Assuming the project were authorized in 1996 permanent reoperation would begin in 2000, the year the current interim plan expires. A PCA (Project Cooperative Agreement) would define the responsibility and schedule for mitigation and the various mitigation elements would be enacted by various agencies such as Reclamation, water contractors, local water agencies, California State Parks and WAPA.

SAFCA would develop and coordinate the agreements with CVP water contractors to allow Reclamation to reduce water demands on reservoirs when necessary for mitigation. The Corps would write a new water control manual and administer project funds. Future anticipated power costs would be paid for as a one-time payment to WAPA and local water supply pumping impacts would also be a one-time project cost. Recreation, cultural resource and fisheries mitigation would also be project costs.

Some of the mitigation features could change from the mitigation described herein as agency negotiations proceed. For example, several water supply mitigation possibilities are discussed in this chapter that could affect the project cost if implemented.

TRANSFER OF FOLSOM FLOOD CONTROL STORAGE SPACE

Studies to date on sizing a flood detention dam near Auburn are based on maintenance of a seasonal flood control storage space of 400,000 acre-feet in Folsom Reservoir. However, it would be possible to increase the size of the detention dam and transfer to it some of the flood space required in Folsom. By so doing, additional seasonal storage space would be "freed up" in Folsom, providing an opportunity to increase water supplies to the CVP and SWP, hydropower generation, and recreation at Folsom. The flood space remaining in Folsom would be used to control storm runoff from the South Fork American River. Reservoir routing studies indicate that about the maximum seasonal reduction in flood space at Folsom Reservoir would be 100,000 acre-feet, and the additional detention requirement at Auburn would be about 70,000 acre-feet.

Reducing the flood space in Folsom by 100,000 acre-feet would result in many years in a small increase in winter recreation use and water supply and power generation because the reservoir would average about 4-10 feet higher from November through March. These benefits are shown in table VII-5.

TABLE VII-5

Costs and Accomplishments of Flood Control Space Transfer

Item	Amount	$
Potential Annual Benefits		
Hydropower (energy increase)	10 GWh	720,000
Hydropower (capacity increase)	1 MW	72,000
Local pumping (energy savings)	0.1 GWh	10,000
Water supply (avg. increased storage)	14,000 ac-ft	1,500,000
Recreation (visitor days)	4,000 visitors (0.2%)	100,000
Total benefit		2,402,000
First Cost to Increase Detention Dam	70,000 ac-ft	25,000,000
Annual Cost		1,940,000
Net Annual Benefits		462,000

Estimates of increases in water supply delivery and hydropower generation were obtained from the PROSIM computer model. Estimates of decreases in the energy required by Folsom area water users to pump water to their facilities and increases in recreation

opportunities were based on monthly average increases in water-surface elevation. The water and power benefits were based on the same water and power values used in the reoperation analysis, about double today's prices. Additional information is in the Montgomery Watson report "Task 3. Folsom/Auburn Area Detention Dam Flood Control Space Transfer," July 1995.

The estimated incremental first cost to increase the total capacity of the Detention Dam Plan described in chapter V by 70,000 acre-feet is about $25 million (October 1995 price levels). The resulting average annual cost (7⅝ percent interest rate and 100-year period of analysis) is $1.9 million.

As shown in table VII-5, the resulting net economic benefits of reducing the flood control capacity at Folsom from 400,000 acre-feet to 300,000 acre-feet and increasing the size of the Detention Dam Plan by 70,000 acre-feet would be about $462,000. Thus, this concept appears to be economically feasible.

The Detention Dam Plan is for a flood-control-only facility. Addition of space at the Auburn site to increase water-supply operations at Folsom would be considered a cost to water-supply beneficiaries. Current Federal cost-sharing policy requires water-supply features to be paid by a non-Federal sponsor.

OUTLET WORKS GATING - FLOOD DETENTION DAM

Significant concern has been expressed over whether the outlet works of a flood detention dam should include gates capable of controlling the outflow. Canyon preservation groups and individuals have expressed fears that inclusion of gates would more easily allow conversion of the facility into a multipurpose (with water supply and hydropower) project. However, gates allow for many benefits ranging from dam and system safety to inundation impact reduction. Accordingly, the FY 93 DoD Act directed that various configurations and capacities of the outlet works of the flood control dam be analyzed to (1) ensure safety of the flood control dam; (2) provide for system safety; and (3) minimize damages to the vegetation, soils, and habitat in the canyon. A full response to the Congressional direction is contained in appendix G and summarized below.

FACTORS EFFECTING GATING

The gating configuration for the detention dam was evaluated on the following factors: (1) dam safety, (2)system safety, (3) canyon sloughing, and (4) vegetation mortality.

Dam Safety

Established practice and policy indicates that unforeseen events could arise that would preclude the sole dependance on ungated outlets for effective evacuation of a flood detention dam. Although a functioning facility could be designed using only ungated outlet works, unsafe conditions could be considered outside the design envelope. As an example, localized outflow velocities could reach magnitudes causing cavitation or erosion to the interior of the outlet works. Without gates, the sluices could not be closed for repairs. However, sluices with gates would provide the highest safety because the gates could be closed if emergency repairs were necessary. Accordingly, from a dam safely perspective, gates should be included in the outlet works.

System Safety

Under existing conditions, the levees along the lower American River are estimated to safely pass 115,000 cfs without failure. However, unforeseen conditions could arise at any floodflow where if would be prudent to have a capability to lessen the flow to the lower river. As an example, if unexpected boils or similar condition were found to exist in the levee system during a high flow event, retarding outflows from Folsom Dam in combination with the detention dam could allow for a greater period of time during which the flow could be reduced to allow for repairs. Accordingly, from a overall system safely perspective, gates should be included in the outlet works.

Canyon Sloughing

Canyon slopes can fail when the gravitational forces on a rock or soil mass are greater than the resisting forces. Sloughing of the slopes in the American River canyon have occurred in the past and will occur in the future—with or without the presence of a flood detention dam. Historic sloughing in the American River canyon was investigated. It was found that there are some slopes in the area that are potentially unstable, as evidenced by historic and prehistoric landslides. This condition was observed when the cofferdam was breached during the February 1986 storm of record in the watershed. Many landslides were observed in the area upstream from the dam. The probable cause for many of these slides was the extremely rapid drawdown (200 ft/hr) of the cofferdam reservoir that resulted in the development of a significant vertical phreatic lag. The phreatic lag is described as the period of time that it takes for water to drain out of saturated soil as the water level of an inundated pool of water drops. In an inundated pool, the immersed soil becomes saturated with water. However, the added weight of the water in the soil is supported by the water within the pool below the given mass of soil; therefore, if the water level of the pool drops quicker than the rate at which the water drains from the soil, the soil no longer has the support of the inundated water. Without the support of the water, the soil cannot sustain its saturated weight and begins to slough off. Evidence shows that control of drawdown rates can significantly reduce additional sloughing associated with pool inundation.

Inundation Mortality

Studies were conducted as part of the 1991 feasibility report and supplemented during preparation of the SIR to estimate the acres of habitat lost during various flood events in the canyon area under varying outlet works configurations. For the 1991 report, it was estimated that up to about 600 acres of vegetation could be lost over the 100-year project life from operation of the then selected 200-year project (545,000 acre-foot flood detention dam). However, should the outlet works be operated during a major flood event to reduce canyon sloping, concern has been expressed that this action could increase losses due to inundation.

As described in chapter 9 of the EIS, several methods were used to estimate the potential losses to oak woodlands, chaparral, grassland, riparian communities, and conifer forests due to brief periods of inundation. One method was to review conclusions reached in the 1991 report and other available literature on inundation and plant tolerance. Another method involved field testing the impacts to various plant species present in the American River canyon in similar inundation environments. One test involved an analysis of impacts to a variety of oak woodland and chaparral tree and shrub species along the Sacramento River below Keswick Dam during high flow conditions. Another test involved (see appendix H) analyzing the response of a variety of immature (seedlings) oak woodland and chaparral plants to a series of submergence trials in Folsom Reservoir. Both field tests involved subjecting plant species during their dormant periods (when flood inundation would occur) to inundation of different durations and noting potential impacts during the subsequent growing season. The basic results of the submergence test was that different plants (types and ages) have a different tolerances to prolonged inundation. Manzanita for example suffered no losses in the experiment whereas chemise and toon suffered almost a 100 percent mortality. Depth did not appear to be a factor in mortality. Duration was the critical factor. During the Keswick study, findings were similar to the submergence study. Accordingly, the study suggested that adding gates to the outlet may also allow a manipulation of the time of inundation to minimize impacts to area vegetation.

OPTIMAL GATING CONFIGURATION

Nine outlet work configurations were analyzed ranging from 12 ungated sluices to 28 gated sluices. The goal of the analysis was to determine a configuration that could provide for maximum dam and system safety, reduced the potential for canyon sloughing, and minimized impacts on vegetation mortality. Studies showed that limiting the drawdown rate to not exceed 1.5 feet per hour for basin depths exceeding 150 feet, and 3.5 feet per hour for depths below 150 feet would result in minimum impact on canyon area sloping. This rate was used in the design of each configuration.

The risk of localized erosion and cavitation in the flood sluices at high flows was determined to be too great to consider ungated outlet sluices. For this reason alone, it was determined that gates would be included in all sluice designs. It should be mentioned, however, that an ungated opening in a diversion tunnel around the dam could be safely

constructed and would not jeopardize the safety of the dam. However, with use of an ungated diversion tunnel, full outflow could not be controlled during a highly unlikely but possible emergency along the lower American River or at Folsom Dam. Accordingly, use of the diversion tunnel was eliminated from further analysis.

To minimize inundation from smaller event flooding, the largest amount of outlet capacity would be the most desirable. It was found that after considering costs for each gate and outlet sluice, the likely optimal outlet capacity to minimize inundation while maintaining an allowable drawdown rate and satisfying safety conditions was a dam with 20 sluices. Twenty sluices would give the dam a high capability of passing smaller flood events, with minimum inundation of the canyon.

The 20 sluices would be 5 feet wide by 10.5 feet high. Each sluice would have a single operational gate and a backup emergency gate. The 20 sluices would be kept open during flood season. Once a flood begins, the sluices would be kept open until Folsom Reservoir is able to discharge the regulated release of 115,000 cfs. After Folsom Reservoir reaches this release rate, a number of the sluices would be closed as required to balance flood control storage between Folsom and the detention dam. Once the peak storm has passed, additional gates would be closed to keep the drawdown rate between 1.5 and 3.5 feet per hour. Following the storm, all the sluices would be opened in anticipation of the next flood event.

EXPANDABILITY OF A DETENTION DAM

The FY 93 DoD Act also directed an analysis expandability of the detention dam. The analysis was to:

- Assess whether any feature or characteristic of the flood detention dam would preclude its efficient expansion for water, power, or other purposes.
- Determine whether the detention dam design would create any greater difficultly for an expanded dam to meet seismic requirements.
- Identify any extra costs attributable to features of an expanded dam which would not have been needed if the features were initially included in the detention dam (advance features).

A full response to the Congressional direction is contained in appendix G and summarized below.

A primary goal in plan formulation for this SIR was to develop alternatives that would meet the stated objectives, with the primary one being flood control, while neither precluding nor promoting the future development within the watershed of other projects.

This was the case in formulating the flood detention dam. Features were considered that neither precluded nor promoted the future expansion of the facility into a multipurpose project.

IMPORTANT FEATURES

Following is a summary of several major project features and requirements and a statement as to whether they would have a bearing on the potential for future expansion of a flood detention dam for other purposes:

Authorization. It is anticipated that the authorization for any project as part of this SIR would focus on the need for flood control and the features to provide it. There is a Federal role in providing flood control. Included in chapter VIII is a description of the current Federal policies for cost sharing flood control projects. Under the policies, there is no direct Federal contribution for water supply and hydropower purposes. Accordingly, any future expansion would need to be consistent with goals, features, and functions of the initial project and be accomplished at non-Federal expense.

Lands. The minimum interest in lands for a flood control project in the American River canyon is fee title where permanent facilities would be constructed and flowage easements on the remainder of the lands in the 6,000 acres needed for the flood detention facility. If a permanent pool was authorized, it would be necessary for the non-Federal sponsor to acquire greater interests in all lands within the design flood storage and any lands needed for public use. The typical minimum interest for these purposes is fee title. Acquisition of these interests (see chapters VIII and X) will be the responsibility of the non-Federal project sponsor (The Reclamation Board). Currently, most of the lands required for the flood Detention Dam Plan have previously been acquired by Reclamation for the Auburn Dam project. For so long as Reclamation has their project authorized, they will not relinquish their underlying fee title. Reclamation will sell flowage easements for ocassional or permanent flooding to the non-Federal sponsor since flowage easements are not incompatible with their authorized project.

Penstocks. If future expansion were to include hydropower generation, penstocks would need to be incorporated as part of the facilities. Penstocks deliver water through the dam to turbines in a downstream powerplant. Penstock construction could include new tunnels through the dam, modification of sluices, or use of the diversion tunnel. The location, type, and size of penstocks would be highly dependent on the ultimate project size, how much power would be generated, and the location of the powerhouse. Penstocks can and have been added to existing concrete dams. Tunnels for the penstock can be accomplished by drilling or similar method without jeopardizing the structural integrity of the structure. The cost difference between initial placement of the penstocks (or placement of a "soft" plug for later excavation) and future tunneling (or other modification) is believed to be minimal. In addition, without an initial firm indication of the overall configuration of the expanded project, any funds initially expended might be forgone if a different configuration

were selected in the future. Accordingly, it is believed prudent to delay installing features for penstocks until an expanded project were constructed.

Water Intake System. If water is withdrawn from a future permanent pool for power, water supply, or low-flow releases, the water would need to be conveyed through a selective withdrawal system. A selective withdrawal system would allow for better control of water temperatures and improved downstream water quality. The system would require a tower, often called a wet well, with openings and control gates at various elevations in the reservoir pool. The wet well can be easily added to the upstream face of any existing or expanded dam. The construction methods to do so are similar, no matter when this would be considered. Accordingly, there would be no cost savings to add a water intake structure as an advance feature.

Gates. The gates identified for the detention dam would be of sufficient strength to handle the higher head from a multipurpose dam. The gates would be designed to be fully opened or closed; however, future requirements for a multipurpose dam would require the installation of hydraulic operating equipment so some of gates could be used to regulate the flow of water. It would be prudent to add equipment at the time of construction of the expanded project.

Foundation. The foundation for a detention dam would be adequate for any expanded project. Additional foundation preparation for an expanded project would need to be accomplished upstream or downstream of the flood detention dam. Competent rock extends on both sides of the detention dam location.

The larger volume of water for an expanded project would require additional grouting to control seepage around the dam. Designs for the detention dam use a single grout curtain to control seepage. A double grout curtain to a greater depth would be needed for a multipurpose dam. The detention dam would include an inspection/grouting gallery. This gallery could be used to add the additional grouting for the expanded project.

Shape of the Detention Dam. The inverted trapezoidal shape of the detention dam is commonly used for gravity dams. This shape is compatible with any expanded gravity dam at the site.

Thermal Impact. The issue of thermal impacts in massive concrete construction is a routine design consideration for possible expansion of dry dams. The construction joints placed in the flood detention dam for thermal stress would be adequate for future thermal stress due to expansion of the dam.

Concrete Strength. A concrete design strength was selected based on results of preliminary material testings. It was estimated in the loading case used for the dynamic analysis that a full flood control pool at the same time as the occurrence of the Maximum Credible Earthquake. It was determined as part of the dynamic analysis that stresses created during an earthquake would be within the allowable stresses. The design for the detention

dam was checked assuming the structure was expanded to a multipurpose facility; for the dynamic loading, the expanded project would also be safe.

CONCLUSION

On the basis of the above, it was concluded that construction of the detention dam would not (1) preclude future expansion of the detention dam for other purposes, (2) create difficulties for an expanded dam to meet seismic requirements, or (3) require greater costs for an expanded project.

EARTHQUAKES AND THE PROPOSED DETENTION DAM

This section addresses the seismic evaluation of the proposed damsite and, if reservoir-induced seismicity would have any effect on the operation of the proposed detention dam based on the known conditions at the damsite. In general, the dam is designed to withstand the Foothills Fault system maximum credible earthquake, whether reservoir induced or not. However, even these conservative values, will continue to be evaluated and updated if the project is authorized.

Seismic Activity and Dam Design Parameters

Woodward-Clyde and other earth scientists working elsewhere within the Foothills Fault system have determined that select, short fault segments within the system have produced earthquakes. In the Auburn area, the Dewitt Fault, one of these short faults segments, is located about 7 kilometers (4.5 miles) north of the Auburn and is considered capable of being an earthquake source. The estimated maximum magnitude of such an event, based primarily on fault length, is M6.1 to M6.3. Therefore, a risk of a damaging earthquake near the City of Auburn exists and is completely unrelated to the construction of any present or future structure or dam. However, this seismic risk is not only from the Foothills Fault system but also from other adjacent California and Nevada Fault systems. There are at least 10 seismic source zones that have the potential for causing damaging ground motions in or near the City of Auburn which could affect unreinforced masonry buildings with historic significance. Seismic investigations for the dam clearly indicate that these types of historic structures are already at great risk, primarily from the highly seismic boundary regions of the Sierra Nevada-Great Valley tectonic block.

The proposed damsite is located in the region of relatively low to moderate seismicity. Historically, occasional tremors have been felt in the Auburn area. Small to moderate earthquakes have occurred in the western foothills of the Sierra Nevada and most seismic activity is concentrated in the Nevada City-Grass Valley area and the Oroville-Chico area. As an important part of the regional Foothills fault system evaluation, the faults mapped by the USBR within the foundation of the originally proposed Auburn Damsite were extensively reviewed by fault study investigators. The results of these studies determined that

the fault and talc zones (F and T zones) within the then proposed Auburn Dam foundation had been emplaced prior to 100 to 120 million years ago, based upon laboratory analyses and dating of mineralization that had occurred within and had healed these zones since their original formation. In addition, with the exception of two faults, F-0 (which is located outside of the foundation area) and F-1, none had moved since that time (Carlson, 1990). Further, these zones have very short lengths ranging from only about 100 meters (328 feet) to about 1-kilometer (3,280 feet). Faults of these short lengths are not considered capable of being the source of large, damaging earthquakes.

Fault F-1, however, was found to have cut across and offset many of these old faults and talc zones and was, therefore, younger. It was eventually determined that F-1 had experienced approximately 2.4 feet of offset over the past 5 to 10 million years. To provide a perspective on how low a degree of movement this is, portions of the San Andreas fault have accumulated over 200 miles of slip during approximately the same time period. However, additional investigations could not prove or disprove actual present-day activity (within the last 100,000 years by USBR's criteria) on fault F-1 owing to a lack of datable geologic units overlying it (Carlson, 1990). It should be noted that F-1 also has a very short fault length of approximately 1,370 meters (4,500 feet) and not the 10's of kilometers necessary to be the source of a damaging earthquake, and also that the F-1 fault does not lay within the presently proposed foundation area (but it is located within the reservoir area).

Fault F-0 was never within the foundation area of the original Auburn dam and is not within the foundation of either the presently proposed detention dam or the multi-purpose dam alternatives. It does, however, pass through the reservoir area. It too has never been proven conclusively to be either active or inactive. CDMG (1979) speculated that it might someday be found to have a structural connection with the Maidu East fault. Since that report, however, the Maidu East fault zone has been trenched and found not to have displaced sediments of at least 100,000 years in age (Carlson, 1990) and as such is not an active or a capable feature by USBR criteria.

Regardless of the geologic evidence proving that there are no capable earthquake faults within the foundation area, the seismic design parameters for the proposed dam alternatives are so conservative that if the MCE of M 6.5, however unlikely, did occur on one of these faults the dam is designed to withstand it.

A finite element analysis was performed on the proposed detention dam utilizing the MCE (Maximum Credible Earthquake) to evaluate the seismic stability of the dam structure. The parameters used were an MCE of magnitude 6.5 with a peak ground acceleration of 0.64g (acceleration of gravity) in the horizontal direction and 0.39g in the vertical direction. In addition, the design used a fault displacement of 9 inches. With the present alignment, the dam is not located on the surface trace of the fault in the footprint of the original arch dam. All seismic parameters were met for the dry dam largely because of the trapezoidal cross-section design of the proposed dam. These parameters are considered conservative for the damsite. It was determined that stresses within the concrete structure during the earthquake event were well within allowable stresses. Therefore, based on the findings of

the earthquake response analysis, it was concluded that the detention dam is capable of withstanding the MCE and post-earthquake loads (hydrostatic pressure and dead weight of the dam) in such a way that no failure triggering a sudden, catastrophic release of water will occur. In addition, other major factors were developed for the dry dam to be build to withstand maximum expected earthquake: concrete gravity design, arched design for stability, large jointed monoliths to accomodate seismic forces, plastic liner to reduce seepage, and an extensive foundation reinforcement.

Reservoir-Induced Seismicity

Reservoir-induced seismicity (RIS) generally refers to shallow microseismic events (or earthquakes) with magnitudes less than 3.5 and with focal depths extending from the surface to no greater than 3 kilometers (1.8 miles). These microearthquakes are generally too small to be felt or to affect engineered structures, and their occurrence can only be detected by highly sophisticated instrumentation (Dr. Ellis Krinitzsky, et al., 1993). Whether potentially damaging earthquakes (magnitude 5.3 and greater) can be triggered by reservoir impoundment remains a subject of great debate among many seismologists, geologists, and geophysicists. Many of these professionals doubt that tectonic earthquakes can be induced; however, if they can, they happen "only where those earthquakes are on the verge of occurring from a natural (tectonic) cause" (Krinitzsky, 1993). Researchers do agree that if it is eventually proven and accepted that some reservoirs do induce damaging earthquakes, then there has to be a preexisting critical state of tectonic stress. Further, it is also very important to note that under the theory of RIS, any earthquake that might result will never be larger than the tectonic seismic event about to occur and never greater than the maximum credible earthquake (MCE) for the region. The argument against damaging earthquakes being attributed to RIS, according to Dr. Krinitzsky (1995), is that earthquakes of these magnitudes occur only as the result of tectonic forces at depths greater than 7 to 12 kilometers (4.5 to 7.4 miles) beneath the surface of the earth's crust, and the forces present at such depths are unaffected by manmade structures.

The August 1, 1975, Oroville earthquake has been extensively studied and analyzed during the last 20 years, and the data indicate that this event was more than likely a normal tectonic earthquake in an area of known seismicity. As a result of investigations since the Oroville earthquake in 1975, most earth scientists now believe that the Sierra Nevada and the Great Valley (Sacramento and San Joaquin Valleys) of California form a single unit or tectonic block within the earth's crust. About 5 million years ago, this block began rising on the east and tilting to the west, and this tilting is still ongoing.

Within the Sierra Nevada foothills, numerous dams and reservoirs on or near the Foothills Fault system have experienced significant episodes of reservoir filling and drawdown, and none have experienced RIS events. For example, the New Bullards Bar Reservoir, located 30 kilometers (19 miles) southeast of Lake Oroville, also meets the RIS criteria, yet has not experienced reservoir-induced seismicity. Other large-to-very-large, deep dams on or adjacent to the Foothills Fault system, other than Oroville and New Bullards Bar, include Folsom, Pardee, New Don Pedro, New Exchequer, and New Melones, and

none of these reservoirs are known to have experienced RIS. In summation, the Oroville earthquake, as discussed above, does not fit the criteria for a damaging reservoir-induced seismic event. This view was echoed by Lloyd Cluff (1995), a recognized worldwide expert on RIS, who has stated that the Oroville event has never been proven to be reservoir induced and that, based on his analyses, it was not.

International criteria have been developed for the occurrence of RIS. These criteria were derived after investigating over 11,000 large dams worldwide; of these only four have been considered as having induced damaging earthquake events equal to or exceeding magnitude M5.7. Of these few worldwide cases of damaging earthquakes that have been documented as possibly reservoir induced, many have occurred in countries where a proper predesign and preconstruction seismic evaluation of the region would have indicated a background seismicity and earthquake activity greater than that for which the structure was actually designed. This is not the case for the proposed Auburn Dam, where highly conservative design values are already in place.

Groups concerned about the Foothills have expressed concern that if a reservoir is constructed, increased seismic activity will occur. Their inference is that if a dam is built to reduce the risk of damaging floods (which have actually occurred within the past 140 years), that this same dam and reservoir will create a new risk that will be greater than the flood risk being mitigated. This inference is clearly in error. Both risks exist simultaneously whether any flood control structure is ever built at the Auburn damsite.

Conclusion

In conclusion, the existence of capable faults near the City of Auburn represents a real and present risk of damaging earthquakes, whether or not a dam is ever constructed. The proposed detention dam will meet most of the worldwide criteria for permanent dams and reservoirs that are thought necessary for an increased probability of risk from reservoir-induced seismicity. Seven other dams which also meet these criteria are located both within the same tectonic stress regime and also on or adjacent to the Foothills Fault system, as is the proposed detention dam, and these dams have not experienced RIS. The proposed detention dam is designed for the maximum credible earthquake and associated ground motion parameters theoretically capable of occurring on the Foothills Fault system. Therefore, the dam would be built to withstand such an event, should it ever occur, whether tectonic or reservoir-induced.

CHAPTER VIII

SELECTED PLAN AND IMPLEMENTATION

This chapter summarizes the selected plan and procedures and cost sharing required to implement the plan.

SELECTED PLAN

The plan selected for recommended implementation in this report is the Detention Dam Plan. Its three principal features are (1) a 508-foot-high flood detention dam on the North Fork American River near Auburn, (2) strengthening existing levees along the lower American River, and (3) strengthening and raising levees on east side of the Sacramento River between the Natomas Cross Canal and the American River. It is described in detail as the third of three candidate plans in chapter V and summarized below.

ACCOMPLISHMENTS

In conjunction with Folsom Reservoir and other existing flood control facilities, the plan would provide the following accomplishments:

- Lower American River. The plan would result in an increase in the level of protection from 1 chance in 100 to less than 1 chance in 500 of flooding in any year. This would reduce the chance of flooding over a 50-year period from 40 percent to less than 8 percent. This level of flood protection would result in a reduction in the average annual flood damages by about 80 percent. Water, power, and recreation resources forgone due to interim reoperation of Folsom Dam and Reservoir for flood protection would be restored.

- Natomas Area. The plan would result in an increase in the level of flood protection in the Natomas area from 1 chance in 140 to about 1 chance in 400 of flooding in any year.

- Lower Sacramento River. The existing level of flood protection varies based on location along the lower Sacramento River (downstream from Sacramento to near Rio Vista). This plan would decrease the likelihood of the existing levees failing by about 90 percent.

- Yolo Bypass. This plan does not include any modifications to the Sacramento Weir and Bypass. Because of the overwhelming influence of the upper Sacramento River and tributaries, inflows from the upper Yolo Bypass, and local tributaries there would only be a small increase in the existing flood protection in the Yolo Bypass near Sacramento.

PLAN COMPONENTS

Detention Dam Area

The peak-flow flood detention dam would be located at river mile 47.2 of the North Fork American River near Auburn. At full capacity, flood storage would be 894,000 acre-feet at a pool elevation 942 feet. Although 6,000 acres of land would be needed for the dam and detention area, the maximum inundation area would be about 5,500 acres during an event with less than a 1 in 500 chance of occurring in any one year. Plate 17 shows the gross pool detention boundary behind the dam. From streambed, the dam would be about 508 feet high. It would be a concrete gravity structure with a base width of about 400 feet and a top width of 25 feet. The dam would be 2,700 feet long at the crest and have a total volume of about 7.6 million cubic yards. Plate 18 shows a plan view of the dam and plate 19 shows the dam in section and profile.

Figure VIII-1 is a computer generated rendering of the dam. Table VIII-1 summarizes the major features and pertinent data of the dam. More detailed information is included in chapter V and appendix E (Designs and Cost Estimates).

Flood releases would pass through 20 sluices 5 feet wide by 10.5 feet high through the dam. The combined releases of these sluices at flood control pool would be 77,000 cfs at gross pool during design event. Each sluice would be fitted with an emergency closure gate and a operational gate. The gates in the sluices would be normally open and used to throttle outlet flows to control the drawdown rate of large floods to reduce the potential for sloughing of the canyon walls. They would also be closed to retard flows from the dam in the extremely unlikely event of an emergency affecting the safety of the dam and/or the downstream flood control system.

The plan includes relocation of State Highway 49 and strengthening of the Ponderosa Way Bridge. The selected relocation for Highway 49 comprises a two-lane bridge across the American River as close as practicable to the existing highway alignment at each side of the canyon. The bridge would be at about elevation 1,000 feet.

To compensate for the potential loss of about 1,370 acres of various habitats in the detention dam area due to construction and operation of the detention dam over the 100-year economic life of the project, the selected plan includes an adaptive management plan and restoration of lands in the Yuba River watershed. Approximately 2,960 acres of land would be purchased from willing sellers along the Yuba River and planted with riparian and upland species. The adaptive management plan is intended to mitigate for the remainder of potential impacts in the canyon and impacts on the threatened valley elderberry longhorn beetle. This plan includes monitoring impacts in the canyon due to project operation and, if required, restoring wildlife habitat, roads, and recreation trails within the project boundaries for inspection and mitigation planting activities. The wildlife habitat restoration would be

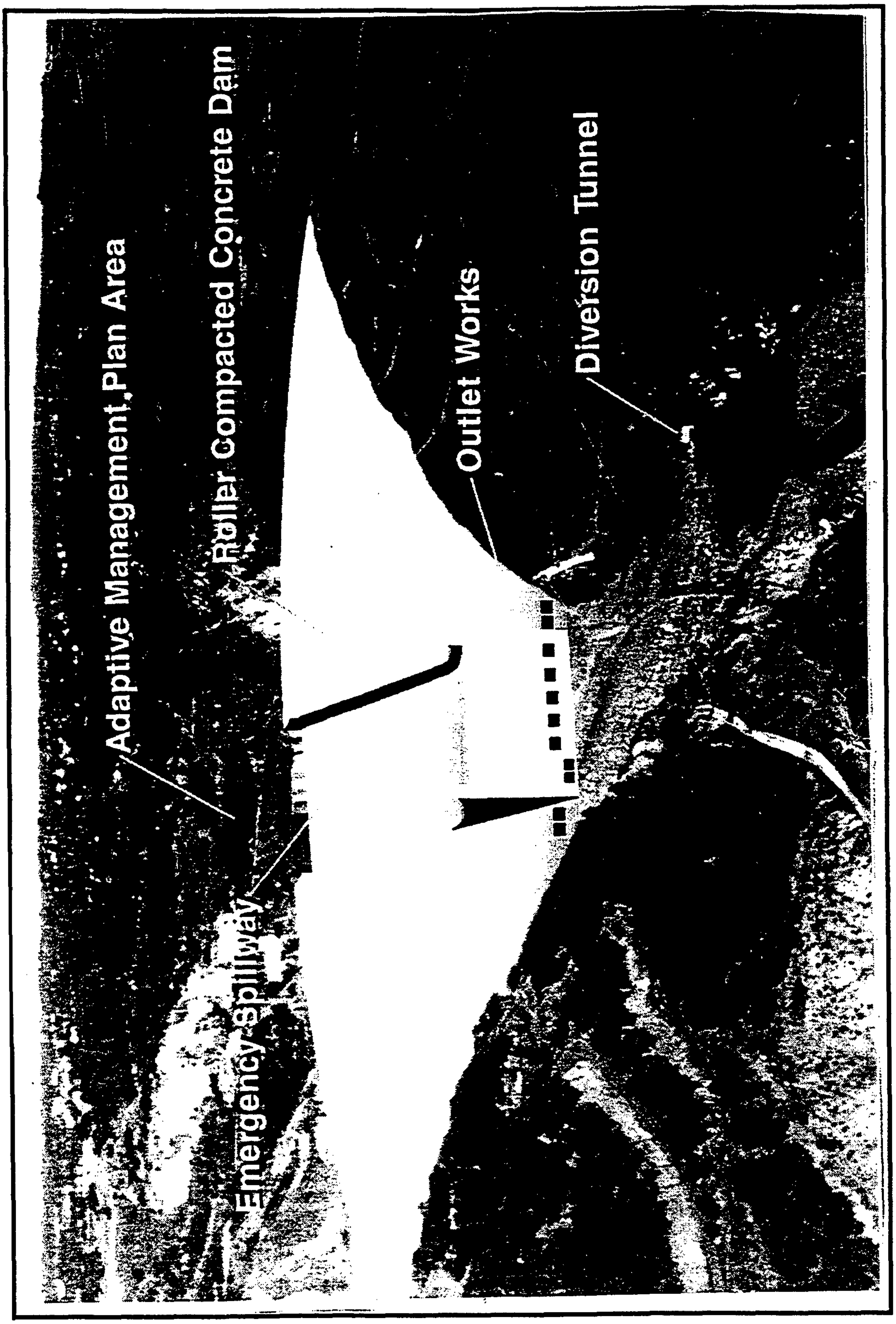


Figure VIII-1. Computer-generated rendering of flood detention dam.

TABLE VIII-1
Pertinent Data - Detention Dam

Item	Data		
State and Counties	California - Placer, El Dorado, Sacramento		
Purpose	Flood Control		
Drainage Area - American River Basin/Damsite (sq mi)	2,100/970		
Flood Plain Area (400-yr acres)	109,400		
Flood Protection Level (chance of flooding)	<1 in 500		
<u>Detention Basin</u>			
Mean annual runoff to damsite (ac-ft) (North Fork American River below Auburn Dam site, 1973-1985)	1,640,000		
100-year peak inflow/outflow (cfs)	237,000/77,000		
200-year peak inflow/outflow (cfs)	298,000/77,000		
Storage Data Event	<u>400</u>	<u>100</u>	<u>10</u>
Peak Storage (1,000 ac-ft)	894	463	80
Elevation (ft-msl)	942	847	677
Surface Area	5,450	3,620	1,100
<u>Dam</u>			
Type	Roller compacted concrete		
Top of Dam/Streambed Elevation (ft-msl)	998/490		
Bottom of Foundation (ft-msl)	450		
Maximum Height Above Streambed (ft)	508		
Crest Length/Width (ft)	2,700/25		
Base Width (ft)	400		
Freeboard Above Spillway Design Flood Pool (ft)	3		
Total Volume of Concrete (cu yds)	6.8 million		
<u>Spillway</u>			
Location	Center of dam		
Type	Ungated ogee with flip bucket into plunge pool		
Crest/Flip Bucket Lip Elevation (ft-msl)	942/589		
Crest Length (ft)	540		
Spillway Design Discharge (cfs)	810,000		
Outlets			
Type	Sluices		
Number & Location	10 in spillway		
Flood Control	4 each side spillway		
Low Level	2 in spillway		
Shape/Height & Width	Rectangular/5 ft. x 10.5 ft.		
Emergency/Operation Gates	2 per sluice		
Peak Discharge	77,000 cfs (at gross pool)		
<u>Lands</u>			
Total required (acres)	6,000		
Detention Dam area	5,500		
Highway 49 and Ponderosa Way	47		
<u>Major Relocations</u> - Highway 49			
Length (mi)	1.8		
Lanes	2		
Bridge Number/Type	4/Post tension concrete		
Height (elev (ft-msl))/Length (ft)	1,000/8,900		
<u>Environmental Mitigation</u>			
General Wildlife, Vegetation, & Fish	- Adaptive management plan on 1,480 acres in detention dam area on north and south forks - Acquisition and vegetation planting on 2,960 acres in the Yuba River watershed.		
Valley Elderberry Longhorn Beetle	- Plant 7008 elderberry seedlings on middle fork		

accomplished over about 1,480 acres and, at minimum, includes planting about 7008 elderberry seedlings for mitigation of lost habitat for the threatened valley elderberry longhorn beetle.

Folsom Dam and Reservoir

Folsom Reservoir operation would return to the 400,000 acre-feet of fixed flood storage from the 400,000/670,000 acre-feet in the without-project operation. The objective release would remain at 115,000 cfs. Returning to the 400,000 acre-feet fixed flood control operation would provide an increase in benefits to water supply, hydropower, recreation, and fish and wildlife resources at Folsom and in the lower American River.

Telemeter Upstream Inflow Gages and Emergency Flood Warning System

Three telemetered gaging stations would be constructed and operated upstream from Folsom Reservoir on the three main forks of the American River. Inflow information would be used to enhance the real-time operation of Folsom during a storm. An improved automated flood-warning system along the lower American River is included to facilitate emergency evacuation of the floodway. (See plate 12.)

Lower American River and Downstream

Work along the lower American River consist of constructing approximately 24 miles of slurry wall in the center of the existing levee. The slurry wall would reduce the chance of seepage through and under the levees. It would allow the levees to withstand higher stages and reduce the chance of stability problems at the existing objective release at Folsom. Plate 13 shows the general location of the levee improvement work.

Natomas

The downstream component of this plan includes raising about 10 miles and strengthening 12 miles of levees on the east side of the Sacramento River downstream from the Natomas Cross Canal. Plate 13 shows the general location of the levee improvement work.

OPERATION AND MAINTENANCE

Once project construction is complete, ownership would be transferred to the local sponsor. The local sponsor would then be responsible for the operation, maintenance, replacement, and rehabilitation of the project in accordance with the water control manual, O&M manual, and initial flood inundation plan.

Operation of the detention dam would be required during floods that would cause a flood pool to rise behind the dam. During the flood season, the gates on the bottom outlet

sluices would be left open to pass the more frequent floods. The gates would be operated to achieve a controlled drawdown rate during the draining part of the flood cycle for the larger, less frequent events. Folsom Dam would be operated as it was prior to the 1994 agreement between the SAFCA and Reclamation. Levees improvements along the lower American River and Sacramento River would be maintained by the State and reclamation districts currently responsible for their maintenance.

The periodic maintenance of the project would be described in an O&M manual prepared by the Corps. All O&M activities would be paid for and accomplished by the non-Federal project sponsors. The non-Federal sponsors would be required to provide the Corps with a semiannual report describing O&M accomplishments.

RELATIONSHIPS WITH OTHER AREA FACILITIES

Relationships with other projects is described in chapter V (Detention Dam Plan). These projects include Folsom Spillway Adequacy, Folsom Dam and Reservoir Reoperation, West Sacramento Project, Sacramento River Bank Protection Project, Sacramento and American Rivers Flood Control Projects, Natomas Levee Construction Project, and the Central Valley Project.

PLAN ECONOMICS

The project first costs was estimated on October 1995 price levels and amounts to $949 million. This cost by primary project element and feature is highlighted in table VIII-2. Estimated average annual costs were based on 7⅝ percent interest rate, a period of analysis of 100 years, and construction ending in 2007. This cost (see table VIII-2) is estimated at $95.3 million.

As shown in table VIII-3, the total average annual benefits are about $186 million. This includes flood control benefits (including flood damage reduction and traffic disruption benefits, and resource replacement benefits) and resources replacement benefits relating from curtailing reoperation of Folsom Dam and Reservoir.

Also shown in table VIII-3, the estimated net annual benefits for this plan are $90.5 million and the benefit-cost ratio is 1.9 to 1.

The levee stabilization work along the lower American River and the Natomas levee improvements can be considered as separable plan elements and as a last-added increment. These features are economically feasible as a last-added increment.

TABLE VIII-2

Selected Plan - Cost Estimate [1]
($ million)

Item	Total Previously Expended Thru FY96	Detention Dam Area	Lower American River	Natomas Area	Total
First Cost					
Lands and management		45.15	2.02	1.51	48.68
Flood control					
Mitigation					
Roads and relocations		104.26	0.0	0.0	104.26
Dam & reservoir		511.97	0.0	0.0	511.97
Levee modifications		0.0	31.16	9.29	40.45
Cultural resources		6.7	0.31	0.09	7.1
Environmental mitigation [2]		15.0	0.0	0.0	15.0
E, D, S, and A [3]	15.0	105.97	10.47	2.1	118.54
Subtotal	15.0	789.05	43.96	12.99	861.0
Creditable expenditures to date [4]	.0	87.7	0.0	0.0	87.7
Total	15.0	876.75	43.96	12.99	948.7
Investment Cost					
First Cost	15.0	876.75	43.96	12.99	948.7
Creditable expenditures to date [4]		-87.7	0.0	0.0	-87.7
Interest during construction [5]	19.93	303.57	30.54	9.96	364.0
Total	34.93	1092.62	74.5	22.95	1225.0
Annual Cost [6]					
Interest and amortization	2.66	83.38	5.68	1.75	93.47
Operation and maintenance	0.0	1.8	0.0	0.0	1.8
Total	2.66	85.18	5.68	1.75	95.27
Annual Benefits					185.8
Net Annual Benefits					90.5
Benefit-Cost Ratio					1.9

[1] October 1995 price levels.
[2] Does not include lands.
[3] Engineering, design, supervision, and administration.
[4] Included in cost apportionment but not economic analysis.
[5] Includes interest on construction expenditures until project year which is 2007.
[6] Investment cost with 100-year economic project life, and 7⅝ percent interest rate.

TABLE VIII-3

Economic Summary of Selected Plan

Item	($ million)
First Cost	948.7
Annual Costs [1, 2]	95.3
Annual Benefits [2]	
Flood control	
Inundation reduction [3]	126.3
Benfits prior to base year	48.6
Bridge replacement	1.2
Resources gain	9.7
Total	185.8
Net Annual Benefits	90.5
Benefit-to-cost ratio	1.9

[1] Includes IDC.
[2] 100-year economic project life and 7⅝ percent interest rate.
[3] Inundation reduction benefits including future growth through project life.

IMPLEMENTATION REQUIREMENTS

REPORT APPROVAL

This final report has been submitted for Corps Washington-level review. As described on the first page of the attached SEIS/EIR, a public notice has been published in the Federal Register (providing a 30-day review period) and the final EIS/EIR has been filed with the EPA. The Washington-level reviewers will coordinate the public comments and make a recommendation to the Chief of Engineers. The Chief of Engineers will submit the report to the Assistant Secretary of the Army (Civil Works), who will, in turn, submit the report to Congress.

Detailed engineering studies and design efforts for the selected plan have been initiated. The results of these studies will be used to prepare plans and specifications for project construction. Initially, these studies will be conducted at Federal expense. This cost will be added to the construction cost and shared with the non-Federal sponsor.

PROJECT AUTHORIZATION

Once the final report is approved and the project is authorized, construction funds will be requested. The project will be considered for inclusion in the President's budget based on national priorities, economic feasibility, level of local support, willingness of the non-Federal sponsor to fund its share of the project cost, and budgetary constraints that may exist at the time of funding. Budget recommendations will be based on evidence of support by the State of California and SAFCA and their ability and willingness to provide their share of project costs. Once Congress appropriates the Federal share of funds for the project, the Assistant Secretary of the Army (Civil Works) and the non-Federal sponsor will sign a formal project cooperation agreement. This agreement will obligate the non-Federal sponsor to participate in implementing, operating, and maintaining the project according to requirements established by Congress and the Administration.

COST-SHARING REQUIREMENTS

Current Federal regulations require non-Federal participation in the financing of projects. In accordance with the Water Resources Development Act of 1986, the non-Federal sponsor's obligations for this project would include:

Flood Control

- Provide all lands, easements, and rights-of-way needed for project construction and operation.
- Perform relocations and alterations of buildings, utilities, highways, bridges (except railroad bridges), sewers, and other facilities required for construction of the project.
- Provide, during construction, a cash contribution of 5 percent of total project costs.
- If the total value of the above requirement is less than 25 percent of total flood control project cost, provide an additional cash payment during the period of construction to make the total non-Federal cost equal to 25 percent of total project costs.
- The total non-Federal first cost will not exceed 50 percent of total project first cost of feasible increments.
- Operate, maintain, replace, and rehabilitate the project after construction.

Recreation

- Provide 50 percent of the separable first cost plus 100 percent of the OMR&R costs.

Environmental Restoration

- Provide 25 percent of the first cost plus 100 percent of the O&M costs.

A letter specifying the non-Federal sponsor's willingness to meet these obligations is included in appendix A (Pertinent Correspondence). However, the non-Federal funds will not have to be provided until after the Congress authorizes the project and appropriates construction funds and a local cooperation agreement is signed. Payment of the funds is to be made at intervals during construction.

COST APPORTIONMENT

Table VIII-4 shows the estimated Federal and non-Federal costs of the selected plan. As can be seen, the estimated Federal share of the total first cost (75 percent) is about $711 million. The estimated non-Federal share is about $237 million (25 percent).

TABLE VIII-4

Selected Plan - Cost Apportionment [1]
($ 1000)

Item	Federal	Non-Federal	Total
First Cost			
Lands and damages	160	35,990	36,150
Relocations	180	104,080	104,260
Construction	552,420	0	552,420
Cultural resources	7,100	0	7,100
Environmental mitigation	15,180	12,350	27,530
Creditable expenditures to date [2]	87,700	0	87,700
E, D, S, and I [3]	113,600	19,940	133,540
Subtotal	776,340	172,360	948,700
Cash adjustment	-64,815	64,815	
Total	711,525	237,175	
Percent of first cost	75	25	

[1] 1995 price levels.
[2] Creditable expenditures to date include some of the costs plus interest incurred by USBR at the Auburn Dam site applicable to a flood detention dam.
[3] E, D, S, and I: Engineering, design, supervision, and inspection.

FULLY FUNDED COST ESTIMATE

Costs presented thus far are first costs at October 1995 price levels. This estimate has been inflated to represent the fully funded amount. The fully funded estimate accounts for future inflation and is based on the current first cost, the schedule at which contracts will be awarded, and assumed annual inflation percentages. It better represents the actual costs that Congress will need to appropriate and the local sponsor will provide in the future to construct the project. The fully funded cost estimate for the selected plan, including $87.7 million of creditable expenditures to date, is $1.08 billion.

FINANCIAL ANALYSIS

The State and SAFCA will jointly provide the non-Federal requirements of the project.

The State (through The Reclamation Board) has a plan for financing its share of the non-Federal costs of a project. It includes authorization (Section 12657 of the California Water Code) for the State to pay for its share of lands, easements, rights-of-way, and relocations on Federally authorized flood control projects in the Sacramento and San Joaquin Valleys. The State, in cooperation with SAFCA, will pay all of the non-Federal capital costs, including the cash requirement, lands, easements, rights-of-way, and relocations, and assure that the project will be maintained to Federal standards. Section 12585.5 of the Water Code provides for the State to pay 70 percent of the non-Federal capital costs; the non-Federal costs of fish and wildlife mitigation; and the non-Federal planning, engineering, and design costs. SAFCA will pay the remaining 30 percent. SAFCA will form a benefit assessment district for flood control in the Sacramento area to fund its share.

The Reclamation Board and SAFCA, as co-sponsors of the project, will be responsible for the operation, maintenance, repair, replacement, and rehabilitation of the completed project. State law requires the Board to pass on these responsibilities and their costs to the local beneficiaries of the project. Maintenance activities will be provided by SAFCA. SAFCA obtains its funds through the benefit assessment district. The Reclamation Board, as a non-Federal sponsor for the feasibility study and non-Federal co-sponsor for the project, will furnish funds for the State's share of project costs by appropriations made by the State legislature.

Based on the financing plans of The Reclamation Board and SAFCA, sufficient funds will be available for all non-Federal costs for whichever plan is selected for recommended implementation.

FEDERAL - NON-FEDERAL RESPONSIBILITY

FEDERAL RESPONSIBILITIES

Preconstruction engineering and design studies will be accomplished by the Corps. Once the project is authorized and a cash contribution, lands, relocations, and assurances are provided by the non-Federal sponsor, the Federal Government will construct the project.

NON-FEDERAL RESPONSIBILITIES

Non-Federal interests would be responsible to:

- Provide without cost to the United States all lands, easements, and rights-of-way necessary for construction and maintenance of the flood control and associated mitigation measures, including all necessary relocations and alterations of buildings, utilities, roads, bridges (except railroad bridges), sewers, irrigation diversions, and related special features.

- Hold and save the United States free from damages due to the construction and subsequent maintenance of the project, except for damages which are caused by the fault or negligence of the United States or its contractors, and if applicable, adjust all claims concerning water rights.

- Maintain, operate, repair, replace, and rehabilitate all completed work, without cost to the United States, in accordance with regulations prescribed by the Secretary of the Army. Monitor the status of completed mitigation and provide periodic reports on its condition, and provide repairs and replacement if needed.

- Provide a cash contribution of 5 percent of the total project cost and an additional cash contribution, if necessary, to bring the non-Federal share to a minimum of 25 percent of the total project cost with credit given for lands, easements, rights-of-way, and relocations. The non-Federal contribution shall be made concurrently and proportionally with Federal expenditures for project construction.

- Comply with the provisions of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970" (Public Law 91-646, 84 Stat. 1894), as amended.

- Comply with the provisions of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (Public Law 96-510, 42 USC 9601-9675). Specifically, the non-Federal sponsor must assume complete financial responsibility for the cleanup of any hazardous material located on project lands and regulated under the Comprehensive Environmental Response, Compensation and Liability Act

(CERCLA) and be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner so that liability will not arise under CERCLA.

PROJECT COOPERATION AGREEMENT

Before construction is started, the Federal Government and non-Federal project sponsor will execute a project cooperation agreement. This contract will define responsibilities of the non-Federal project sponsor for project construction and operation.

PROJECT SCHEDULE

If the project is authorized in 1996, construction activities could be started as early as 1997. Figure VIII-2 shows the schedule for the approval and construction phases of the project.

DEPARTURES FROM FEASIBILITY REPORT SELECTED PLAN

PROJECT FEATURES

Table VIII-5 compares the project purposes, level of flood protection achieved, and principal physical features of the Selected Plan presented in the December 1991 feasibility report, as modified by the 1992 Chief of Engineers Report, to the currently identified Selected Plan. Major features of the 1991 report were a 545,000 acre-foot flood detention dam on the North Fork of the American River and levee and channel improvements at various locations around the Natomas area of Sacramento. As mentioned, major features of the currently Selected Plan include (1) an 894,000 acre foot flood detention dam, (2) stabilization of existing levees along the lower American River, (3) modification of an existing levee along the east side of the Sacramento River downstream from the Natomas Cross Canal, (4) telemetered upstream inflow gages and emergency flood warning system improvements, and (5) returning the flood control operation of Folsom Reservoir to a maximum seasonal space of 400,000 acre-feet.

The reason for the increased detention dam capacity is primarily due to the request by the non-Federal project sponsors to achieve the highest level of flood protection economically feasible in the area. The reason for the reduction in levee modification in the Natomas area is that much of the work identified in the 1991 report was authorized in the FY 93 DoD Act and is under construction by SAFCA. The remaining levee modification along the Sacramento River have been identified through the use of additional hydraulic analysis and recently developed risk and uncertainty statistical modeling. The addition of levee

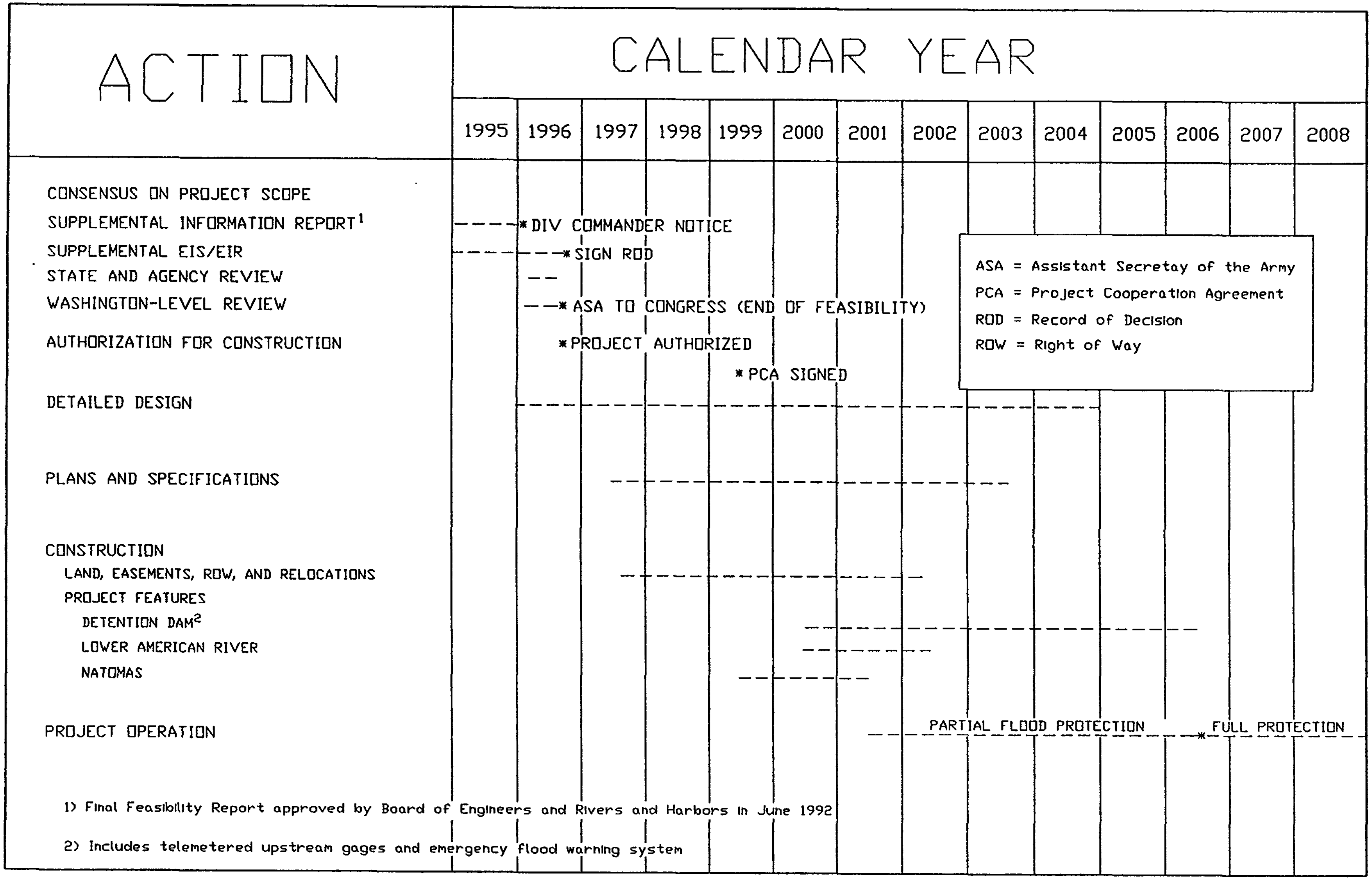


Figure VIII-2. American River Watershed Project Schedule

TABLE VIII-5

Changes in Pertinent Date - Selected Plans

Item	1991 Feasibility Report	1996 SIR
Purpose Level of flood protection (return period - yrs)	Flood Control and Recreation 200	Flood Control >500
Detention Dam Maximum storage (1,000 acre-feet) Elevation (ft-msl) Surface area (acres)	 545 868.5 4,000	 894 942.0 5,450
Dam Top-of-dam elev. (ft-msl) Max. Ht.above streambed (ft) Crest length/width (ft) Volume of concrete (mil cu yds)	 923.7 475 2,600/25 5.2	 998.0 508 2,700/25 6.8
Spillway Crest elevation (ft-msl) Crest length (ft) Design discharge (cfs)	 868.5 600 860,000	 942 540 810,000
Outlets Type & number Width x height (ft) Emergency gates Peak capacity Relocations	 Sluices - 12 5 x 9.5 1 per sluice 7,250 cfs each Highway Bridge 49 & Ponderosa Way Bridge	 Sluices - 20 5 x 10.5 2 per sluice 77,000 cfs Highway Bridge 49
Lands (acres) Total required Detention dam area Relocations Environmental mitigation	 11,483 6,032 66 5,385	 8,060 5,500 47 2,960
Environmental mitigation (General)	- Acquire & plant vegetation on 2,685 acres - South Fork American River - Adaptive management plan in detention area	- Acquire & plant vegetation on 2,960 - Yuba River watershed - Adaptive management plan on 1480 acres - detention dam area
Valley elderberry longhorn beetle	Acquire land & plant elderberry shrubs on 2700 acres - South Fork American River	Plant 7,008 elderberry seedlings
Lower American River Levee stabilization (miles) Method	 None	 24 Slurry wall
Natomas Area Levee modifications & related facilities Recreation Features	 Numerous locations on NEMDC, NCC , &Tributaries Pedestrian/Biking & Equestrian Trails	 13 miles along Sacramento River Not a feature
Upstream Gages and Flood Warning	Not a feature	3 gaging stations and warning system
Folsom Dam and Reservoir Modify flood control operation	 Not a feature	 Return operation to 400,000 ac-ft flood space

stabilization work along the American River also resulted from the use of updated hydraulic and risk based modeling for evaluating levee performance. The inclusion of the telemetered upstream inflow gages and emergency flood warning system improvements is resulted from analysis concluded by the Corps and Reclamation presented in the Folsom Flood Management Report. The need to returning the flood operation of Folsom Dam and Reservoir to 400,000 acre-feet has resulted from a 1994 agreement between SAFCA and Reclamation to increase the storage space until there is a long-term project implemented. The additional reoperation of Folsom is not needed should new dedicated flood control storage be created upstream from the reservoir.

BENEFITS AND COSTS

Table VIII-6 summarizes the costs and benefits of the 1991 feasibility report and current SIR selected plans. After adjustments to reflect current price levels and discount rates, the total first cost for the SIR selected plan is about $66 million more costly than the plan in the 1991 feasibility report. The reasons for the cost increase are (1) larger sized detention dam and appurtenances and (2) net additional downstream levee and related improvements for the current plan. In the 1991 report, the Natomas project element amounted to about 7 percent ($49 million in 1991 prices and $62 million in 1995 price levels) of the total project costs. Accordingly, about $820 million of the 1991 Selected Plan was for the detention dam feature. An estimated $888 million of the current Selected Plan is for the detention dam features. This difference ($60 million) represents the costs for the larger sized detention dam. The features in Natomas (east levee of Sacramento River and levee stabilization along lower American River) amount to about $71 million, which was not included in the 1991 plan.

Table VIII-6 also shows the changes in expected benefits. The currently estimated benefits are similar to those for the Selected Plan in the 1991 report (after adjusting by changes in price levels and interest rates). The inundation reduction benefits are significantly reduced for the current plan. The primary reason for the reduction (even though the level of flood protection is greater) is that a without project condition in the current plan is that Folsom Dam and Reservoir is indefinitely reoperated to provide a minimum 100-year level of flood protection. Crediting the flood control benefits forgone due to reoperation to the current Selected Plan (and deleting benefits from resources replacement due to reoperation) would yield a average annual inundation benefit of about $155 million, which is about 7 percent greater than the updated inundation reduction benefits in the 1991 report. The 1991 report included location benefits for future development and for recreation features in the Natomas area. Although neither benefit is included in the current plan, it does include benefits attributable to regaining resources forgon due to reoperation and benefits accrued during the construction period (similar to interest during construction).

TABLE VIII-6

Detention Dam Plan Cost Estimate Comparison
($ 1,000)

Item	1991 Feasibility Report		1996 SIR
	October 1991 Price Level & 8-3/4 % Discount Rate	October 1995 Price Level & 7-5/8 % Discount Rate	October 1995 Price Level & 7-5/8 % Discount Rate
First Cost	698,000 [1]	882,000	948,700
Average Annual Cost	69,500	76,500	95,300
Annual Benefits			
Flood control			
Inundation reduction	134,010 [1]	144,800	126,300
During Period of Analysis	0	0	48,600
Location	24,000 [2]	24,960	0
Flood proofing saving	6,400	8,690	0
F.I.A. savings	170	200	0
Bridge replacement	1,770	2,080	1,230
Resources replacement	0	0	9,710
Recreation	1,500	1,710	0
Total	167,850	182,440	185,840
Net Annual Benefits	98,350	105,940	90,540
B/C Ratio	2.4 to 1	2.4 to 1	1.9 to 1

[1] Significantly greater share of costs and benefits attributable to Natomas project element than in 1996 SIR.
[2] All of benefit attributable to Natomas protection.

CHAPTER IX

COORDINATION

COMPLIANCE WITH CONGRESSIONAL DIRECTION

In the legislation authorizing additional studies on flood control needs and solutions (FY93 DoD Act), the Congress requested specific information on a number of related topics. These are summarized here with a brief explanation of how they were addressed. Most are discussed in detail in Appendix D, Plan Formulation, or in chapters IV, V, or VII.

- *Paragraph (a) CONTINUATION OF ENGINEERING AND DESIGN.—The Secretary of the Army is directed to reevaluate the project for flood control and recreation, Sacramento and American Rivers, California, as described in the feasibility report of the Chief of Engineers, entitled the "American River Watershed Investigation," dated July 1, 1992, subject to the provisions of this section.*

  This paragraph directed the Secretary of the Army to reevaulate the project described in the feasibility report. The SIR and its findings constitutes compliance with this direction.

- *Paragraph (b) NATOMAS LEVEE FEATURES.—*

  (1) CONSTRUCTION.—The Secretary of the Army is authorized and directed to construct the Natomas levee features of the project as described in the feasibility report referred to in subsection (a), subject to entering into appropriate local cost-sharing agreements from the non-Federal sponsors of the project, provided that such construction does not encourage the development of deep flood plains.

  (2) CREDIT FOR CERTAIN NON-FEDERAL WORK.—The Secretary of the Army shall credit against the non-Federal share of the cost of construction under paragraph (1), or reimburse the non-Federal sponsors, for any planning and construction work performed by the non-Federal sponsors to protect the Natomas area which is commenced prior to the Army Corps of Engineers' receiving appropriations to initiate such construction and which is consistent with the feasibility report referred to in subsection (a).

  This paragraph (1) authorized the Secretary of the Army to construct the Natomas features described in the feasibility report and (2) directed the Secretary to credit or reimburse the sponsor for any planning and construction work performed by the sponsors which is commenced prior to the Corps receiving appropriations to initiate such construction. SAFCA (sponsor) has decided to construct the Natomas features and expects to complete the work in late 1996. The Corps and SAFCA are

developing a credit/reimbursement agreement that will define the Federal/sponsor obligations and sharing of costs.

- *Paragraph (c) GATING AND EXPANDABILITY REPORT.—The Secretary of the Army is directed to submit a report which (1) analyzes the outlet design of the flood control dam at Auburn, including an analysis of various configurations and capacities of gates to ensure the safety of the flood control dam itself, to provide for system safety, to minimize small event flooding of the Auburn Canyon, and to minimize damages to the vegetation, soils, and habitat in the canyon; and (2) includes further analysis as to whether any feature or characteristic of the flood control dam would preclude its efficient expansion for water, power, or other purposes, and whether the design would create any greater difficulty for an expanded dam to meet seismic requirements than a multipurpose dam would otherwise encounter, and further assessment of the extra costs attributable to installation into an expanded dam such penstocks, operational gates and other features of a multipurpose dam which would not be included in an expandable dam lacking advanced features.*

  A gating and expandability report was prepared which summarizes the results of a number of investigations conducted to address this request. Results of the report are presented in appendix G and summarized in chapter VII. A new gating configuration was selected that would increase the level of protection, eliminate sloughing effects, and reduce inundation impacts. In addition, the dam was designed to not preclude the later expansion to a multipurpose facility. The current design will allow expansion to add other project purposes at a later date and fully meets seismic requirements for a large dam, including a multipurpose facility.

- *Paragraph (d) REPAYMENT OF DESIGN WORK.—The non-Federal share of the costs of the design and reevaluations described in subsection (a) shall not be required to be repaid until after the execution of the agreement required by section 103(j) of the Water Resources Development Act of 1986 and immediately prior to the initiation of construction of the project or the appropriate separable element.*

  This paragraph directed that costs of designs and revaluations required by paragraph (a) not be repaid until after execution of a Project Cooperation Agreement. All costs for the SIR are funded by the Federal Government and will be included as part of the total project cost and cost shared in accordance with Section 903 of WRDA 86.

- *Paragraph (e) SPECIAL EVALUATION REPORTS.—*

  (1) In carrying out the reevaluation described in subsection (a) and in consultation with the State of California, the local non-Federal sponsors, and other interested groups, the Secretary of the Army shall perform further evaluation of,

and . . . submit . . . a report on, other features and operational procedures that should be implemented in a coordinated plan to provide flood protection sufficiently high for a major urban area subject to risk of frequent floods causing great economic, environmental, and social damage.

i. The reliability, costs, environmental impacts, and public safety risks associated with increasing objective flows in the lower American River above the 115,000 cfs design capacity, as well as the costs and impacts of permanent reoperation of Folsom Reservoir at different levels of increased flood storage, including the appropriate alternatives for sharing cost associated with Folsom Dam.

Several measures and alternatives were analyzed involving increased objective releases up to 235,000 cfs. These are summarized in chapter IV and described in detail in appendix D. In general, increasing the objective release would not be a cost-effective increment in alternative flood protection plans. However, one of the three candidate plans includes increased objective releases as a principal feature. (See chapter V.)

Several levels of permanent reoperation were examined in a separate report on Folsom Dam and Reservoir reoperation, and the concept was used in formulating flood damage reduction measures and alternatives in appendix D. Reoperation is a cost-effective means of increasing flood protection for Sacramento and was included in several of the alternative plans. (See chapters IV and V.)

ii. The costs and benefits of lowering the spillway at Folsom Dam in order to improve the dam's ability to pass a maximum probable flood and improve its operational flexibility for flood control.

Lowering the spillway a maximum of 15 feet is a feasible increment in several alternatives, including two of the three candidate plans (appendix D and chapter V).

iii. The costs and benefits of transferring flood control obligations from Folsom Reservoir to a new flood control facility at Auburn, increasing the Folsom Reservoir's capability for water supply.

The space transfer concept was addressed in a separate report and is summarized in chapter VII. In general, a small amount of water supply could be developed by transferring the flood storage obligation from Folsom to Auburn. However, at best it would cover the cost of increasing the size of the detention dam at Auburn. Because of the need to provide protection to Sacramento from American River flows originating on the South Fork, the amount of space that could be transferred becomes limited for high levels of flood control.

iv. The costs and benefits of using existing and increased flood space in the upstream reservoirs to enhance the flood control capability at Folsom Dam and of establishing offstream storage in Deer Creek.

Crediting up to 200,000 acre-feet of available space in upstream reservoirs in combination with increased space in Folsom Reservoir was shown to be an effective means of increasing flood control. This was incorporated into a revised operation for Folsom, which is discussed in chapter III under the without-project conditions. Permanent crediting of higher levels of space in upstream reservoirs for flood control is not economic due to the value of lost water supply and hydropower. These concepts are included in flood protection measures discussed in appendix D and in chapter IV.

Establishing flood control storage offstream in the Deer Creek/Cosumnes River watershed was addressed in a separate report and as a flood protection measure in appendix D. Due to high costs associated with connecting channels, detention facilities, and environmental damages, this concept was not economically feasible.

- *Paragraph (e) (2) The Secretary of the Army shall consult with, and solicit the views of, the National Academy of Engineering on the contingency assumptions, hydrological methodologies used in preparation of the American River Project, and other engineering assumptions and methodologies influencing the scope and formulation of the American River flood control alternatives.*

In 1992, Congress directed the Corps of Engineers to solicit the views of the National Academy of Engineering on the methodologies used in developing the feasibility studies and in evaluating alternatives for flood control for the American River basin. Pursuant to that request, the Water Science and Technology Board of the National Research Council established the Committee on Flood Control Alternatives in the American River basin. This committee began its work in October 1993.

The committee investigated both the Corps 1992 feasibility report and the policy and procedures used to develop this supplemental report. The committee's findings and recommendations emphasized that the flood threat facing Sacramento is severe (possibly underestimated) and that a decision on implementing a flood control plan should proceed without further delay. The committee noted that even with the minimum level of protection desired by the local governments (200 year) the risk of flooding would be substantial for over 400,000 people in the flood plain. The committee encouraged decision makers to establish and implement a flood risk management program for the lower American River as rapidly as possible.

According to the committee ". . . nothing stated in this report should be used as an excuse for delaying action in the American River basin. It is time to select and implement appropriate flood risk reduction strategies." The committee found that studies carried out by the Corps provided an adequate basis for selection of a flood plan.

- *Paragraph (f) The Secretaries of the Army and Interior shall jointly develop and implement a flood management plan for the American River and Folsom Dam that insures prompt, reliable, and full utilization of the flood control capability at Folsom Dam and other existing water resources development projects located in the American River watershed, California.*

The Flood Management Plan was completed and published in March 1995. Most of the features recommended in the plan are considered part of the without-project condition described in chapter III. Several of the features, including telemetering of streamflow gages on the three forks of the American River and extending the lower American River flood-warning system to Sunrise Boulevard, are included as measures in the various flood protection alternatives described in chapters IV and V and in appendix D.

A March 23, 1993, letter from Congressmen Fazio and Matsui much of this direction as restarted. Two additional items were included in that letter.

- *The enlargement of Folsom Dam's outlet capacity that would maximize the dam's flood storage usefulness, including the possible contribution the existing Folsom Diversion tunnel might make.*

Several measures were addressed that would improve the outlet capacity of Folsom Dam. These are discussed in the plan formulation appendix and summarized in chapter IV. Lowering the main spillway 15 feet, enlarging the existing river outlets, and modifying them to make full releases conjunctively with spillway releases are included as cost-effective increments in one of the candidate plans (chapter V). Due to its location, the costs of modifying the existing diversion tunnel are greater than the benefits desired. (See appendix D.)

- *The pros and cons of enlarging Folsom Reservoir.*

Several ways of increasing the storage capacity of Folsom Reservoir are discussed in appendix D. Raising the dam and facilities is not cost effective. However, structural modifications to allow increased use of existing surcharge storage for flood control are included in two of the candidate plans (chapter V).

COORDINATION

The American River reevaluation has been extensively coordinated with numerous agencies, organizations, special-interest groups, and individuals, including those who participated in the feasibility study. Coordination has included meetings with a wide variety of interests, presentations to special-interest groups and organizations, media interviews, and public workshops and meetings.

Key among these public meetings were:

- A series of three general forums held in 1993 and 1994 that included all the affected and interested groups in the reevaluation process.
- Meetings of the Lower American River Task Force, a large coalition of flood control and environmental agencies and organizations that have worked cooperatively to address issues along the lower river, including streambank protection, restoration, and recreation.
- A series of six public workshops and hearings held by The Reclamation Board and SAFCA in December 1994 and January and February 1995 on the Alternatives Report.
- Four formal public hearings and six public open houses were held in August through September 1995 were held during the review period on the draft SIR. At the close of the comment period for the draft SIR, approximately 2,500 comments were received on the August draft of the SIR. These comments and their responses are contained in the Comments and Responses Appendix.
- Two public hearings were held by the Reclamation Board and two by SAFCA to deliberate selection of a locally preferred plan in October and November 1995. Copies of subsequent resolutions by each body identifying the Detention Dam Plan as the locally preferred plan are contained in the Pertinent Correspondence appendix.

VIEWS OF OTHERS

As mentioned, October and November 1995, The Reclamation Board and SAFCA held public hearings (as described above) to deliberate selection of a locally preferred plan. As part of these and proceeding public hearings, it was noted that, in general, support for a flood protection project for Sacramento is strong among local agencies, organizations, and individuals. Views differ about the best plan, however. Some interests committed to a very

high level of protection support a flood detention dam, whereas others believe a multipurpose facility should be built. Other interests oppose a dam, fearing substantial damage to natural and cultural resources in the canyon, and support a lower level of protection that could be provided by improvements at Folsom Dam and Reservoir and areas downstream.

CHAPTER X

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Major conclusions of the American River studies are:

- The potential for high flows along the American and Sacramento Rivers and major flooding in the Sacramento area is substantial.

- Besides flood control, there is a growing need in the American River area for additional water supplies and electric power. There is also a significant need for additional recreation opportunities and environmental restoration along the lower American River.

- Alternatives that include increasing the objective release from Folsom Dam (and associated levee modifications along the lower American River) require levee, channel, and bypass modifications downstream from the American River to offset adverse hydraulic impacts.

- Because the modification of many levees in the Natomas area is under way by the SAFCA, the Natomas area will have a moderately high level of protection regardless of conditions along the American River.

- Of nine alternatives evaluated, three best satisfied the flood control and other water resources-related needs of the study area.

  \- The Folsom Modification Plan is the least costly plan and would provide substantial net economic benefits. However, it also would provide the lowest level of protection and leave the Sacramento area with a high residual risk of flooding.

  \- The Folsom Stepped Release Plan would provide a high level of protection to Sacramento but includes individual measures that, by themselves, are not economically feasible. Because of the inclusion of these measures, this plan provides the least net economic benefits. This plan provides opportunity for additional recreation resources and environmental restoration along the lower American River.

- The Detention Dam Plan would provide the highest level of protection to Sacramento, but at the greatest cost. It is that plan that maximizes net economic development (NED) benefits. This plan would do the most to relieve the flood threat to Sacramento.

- The National Academy of Engineers reviewed the findings in the December 1991 feasibility report and subsequent documentation and concluded that although in certain areas additional information is required prior to project construction, sufficient information is available to select a project for ultimate construction.

- The Reclamation Board and SAFCA Board have identified the Detention Dam Plan as the locally preferred plan and recommended it be implemented.

- The selected plan has been formulated to neither enhance nor preclude development of the Auburn project site for multipurpose use.

- The selected plan allows for the retention of all Federal lands although the non-Federal sponsor will pay fair market value for easement rights within the detention basin.

- The Reclamation Board has indicated a willingness to pay for a portion of the selected plan and be responsible for the operation and maintenance of the completed project.

RECOMMENDATIONS

I recommend that the selected plan providing a decreased chance of flooding in any year in Sacramento to less than 1 chance in 500, as described in this report, be authorized for construction as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. This selected plan is estimated to have a first cost of $948.7 million (October 1995 price level). Of this cost, about $711.5 million will be the responsibility of the Federal Government and $237.2 million will be the responsibility of the non-Federal sponsor. The project will include (1) construction of a flood control detention dam near the Auburn Dam site, (2) implementation of a telemetered inflow gage system and emergency flood warning system, (3) construction of a slurry wall in existing levees along the lower American River, and (4) levee improvements along the east side of the Sacramento River downstream from the Natomas Cross Canal. It is also made with the provision that before implementation, non-Federal interests will, in addition to the general requirements of law for this type of project, agree to comply with the following requirements:

- Provide all lands, easements, and rights-of-way necessary for construction (including mitigation), operation, and maintenance of the project, including suitable borrow and disposal areas, and all necessary relocations.

- Accomplish, without cost to the United States, all necessary alterations and relocations to roads, railroads, bridges (except existing railroad bridges), pipelines, cables, and other facilities, including interior drainage facilities, required by construction of the project.

- Hold and save the United States free from damages due to the construction and subsequent maintenance of the project, except for damages which are caused by fault or negligence of the United States or its contractors, and if applicable, adjust all claims concerning water rights.

- Comply with the provisions of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (Public Law 96-510, 42 USC 9601-9675). Specifically, the non-Federal sponsor must assume complete financial responsibility for the cleanup of any hazardous material located on project lands and regulated under CERCLA and be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner so that liability will not arise under CERCLA.

- Maintain, operate, repair, replace, and rehabilitate all completed work without cost to the United States in accordance with regulations prescribed by the Secretary of the Army, including protecting the channel and other flood control works from future encroachment or obstruction, including sedimentation and vegetation, that would reduce their flood-carrying capacity or otherwise impair them. Monitor the status of completed mitigation and provide periodic reports on its condition, and provide repairs and replacement if needed.

- Operate, maintain, repair, replace, and rehabilitate without cost to the Federal Government for the economic life of the project the recreation areas and all related facilities.

- Provide a cash contribution of 5 percent of the total cost of project features assigned to flood control, and an additional cash contribution, if necessary, so that the non-Federal contribution is not less than a minimum of 25 percent of the costs of project flood control features, with credit given for lands, easements, rights-of-way, and relocations. The non-Federal contribution shall be made concurrently and proportionally with Federal expenditures for project construction.

- Participate with and comply with applicable Federal flood plain management and flood insurance programs.

- Inform affected interests, at least annually, regarding the limitations of the protection afforded by the project.

- Prevent encroachments within the channels and other project works which would adversely affect the proper functioning or efficient operation and maintenance of the project works.

- Publicize flood plain information in the areas concerned and provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to ensure compatibility between future development and protection levels provided by the project.

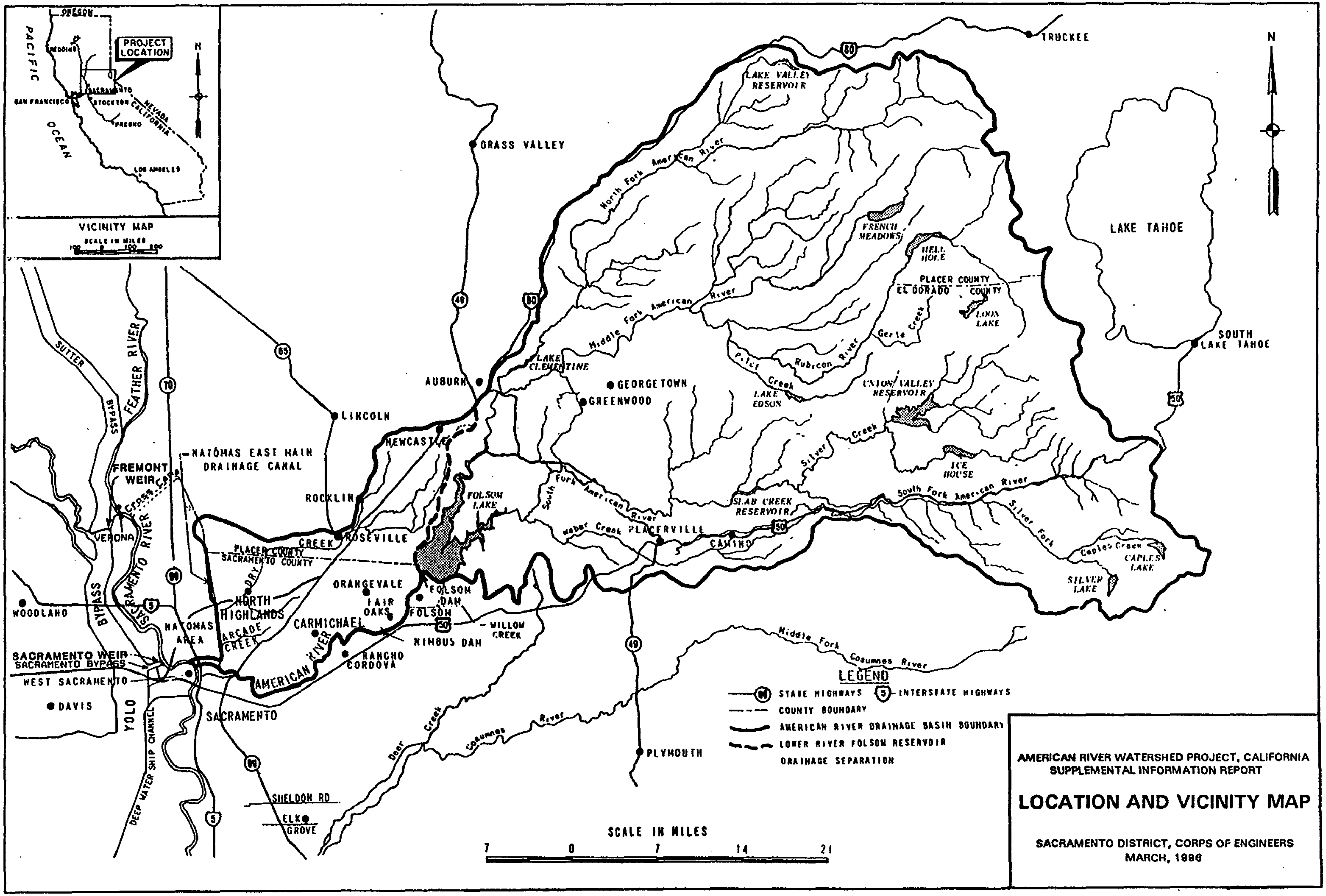
- Assure that construction and maintenance of any non-Federal flood control features do not diminish the flood protection provided by the authorized project plan.

If the feasibility report is approved by the Secretary of the Army, the Secretary will recommend that if non-Federal project sponsors construct the gaging and flood warning system, slurry wall in levees along the lower American river, and/or levee modifications along the east side of the Sacramento River as described in this report, prior to the Army Corps of Engineers receiving appropriations to initiate construction of the authorized project, that such work may be credited toward the non-Federal share of the flood control project and that all facets of the credit are covered in one local cooperation agreement. The amount of credit and the means of crediting shall be determined by the Assistant Secretary of the Army (Civil Works) and be set forth in the project cooperation agreement for the project. In no case will the credit include any interest or be more than the lesser of actual costs incurred by the non-Federal sponsor or the cost that would have been incurred by the Federal Government had the Federal Government accomplished the same work during the same time period. The credit will not relieve non-Federal interest of the requirement to pay 5 percent of the total flood control project cost in cash during construction of the remainder of the project. Approval of the work accomplished by non-Federal interests shall not commit the Federal Government to any type of reimbursement if the Federal project is not undertaken.

These recommendations reflect the information available at this time and current Department of the Army policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are sent to the Congress as proposals for authorization and/or implementation funding.

John N. Reese
Colonel, Corps of Engineers
District Engineer

PLATES

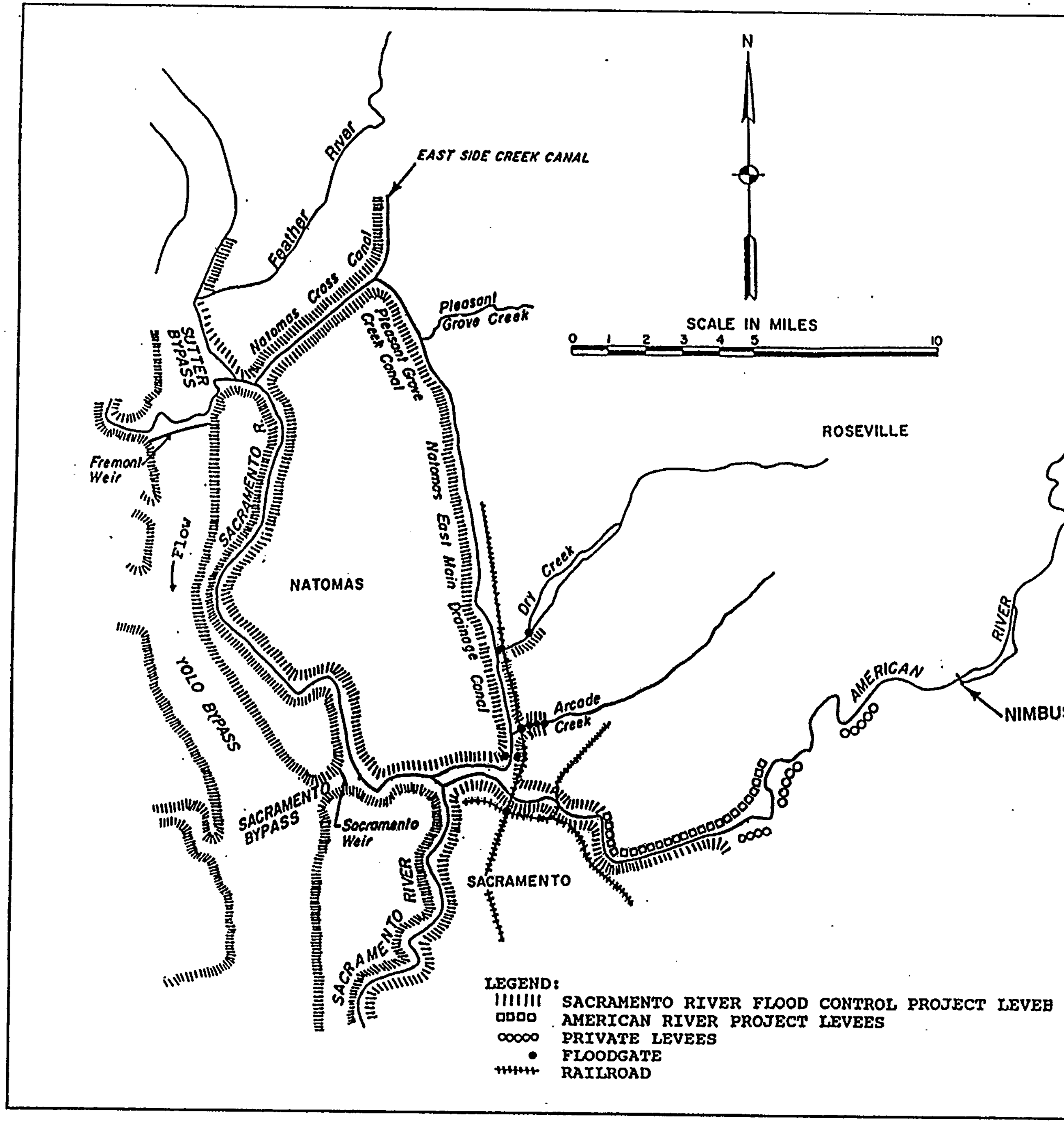


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

LOCATION AND VICINITY MAP

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

PLATE 1



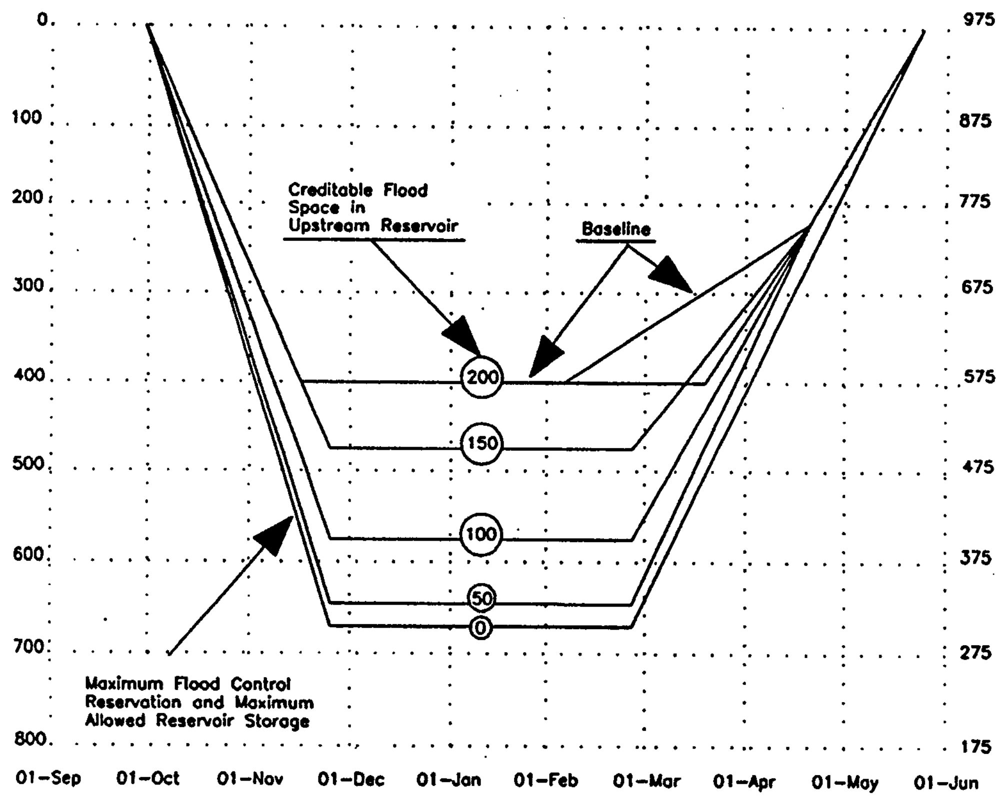
AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

EXISTING FLOOD CONTROL FEATURES IN THE SACRAMENTO AREA

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

PLATE 2

FLOOD CONTROL DIAGRAM FOR FOLSOM DAM AND LAKE



SAMPLE COMPUTATION

RESERVOIR	STORAGE ON JAN 1 (TAF)	STORAGE AT SPILLWAY CREST (TAF)	SPACE AVAILABLE (TAF)	MAXIMUM CREDITIBLE SPACE (TAF)	CREDITIBLE FLOOD CONTROL TRANSFER SPACE (TAF)
French Meadows	75.7	110.7	35.0	45.0	35.0
Hell Hole	87.6	207.6	120.0	80.0	80.0
Union Valley	170.1	235.1	65.0	75.0	65.0
Total Creditable Flood Control Storage Space					180.0
Flood Control Reservation at Folsom Lake					420.0
Required Reservoir Storage at Folsom Lake (TAF)					555.0

USE OF DIAGRAM

1. Folsom Dam and Lake shall be operated for flood control in accordance with the Flood Control Reservation, reservoir releases must be in accordance with requirements of this diagram.

2. The parameters on the flood control diagram define the required Flood Control Reservation, on any given day, based on available space in the upstream reservoirs. Once the required Flood Control Reservation is computed, the Required Reservoir Storage for flood control can be determined. Water stored in excess of the Required Reservoir Storage must be evacuated. Computation of the parameter is discussed below:

FOLSOM DAM AND LAKE
COMPUTATION OF REUQIRED RESERVOIR STORAGE

1. Compute space available below spillway crest, in acre-feet, for the following reservoirs: French Meadows, Hell Hole, and Union Valley.
2. The amount of creditable flood control transfer space in each reservoir is then computed by taking the smaller of the space available or the maximum creditable space for that reservoir.

   a. The maximum creditable space by reservoir is as follows:
      French Meadows - 45,000 acre-feet
      Hell Hole - 80,000 acre-feet
      Union Valley - 75,000 acre-feet

3. Determine the Flood Control Reservation at Folsom Lake by Applying the creditable flood control transfer storage space (parameter on the diagram in 1,000 acre-feet).
During a potential flood situation, water stored within the flood control reservation defined hereon, shall be released as rapidly as possible subject to the following schedule:

   a. Reuqired flood control release - Promptly release inflow up to 115,000 CFS while inflows are increasing, as dicussed in the Folsom Dam Release Schedule. Control flows in the American River below the dam to not more than 115,000 cfs, except when larger releases are required by the accompanying EMEMGENCY SPILLWAY RELEASE DIAGRAM (ESRD). Once the reservoir pool begins falling, maintain releases in excess of inflow until water stored in the Flood Control Reservation is evacuated.

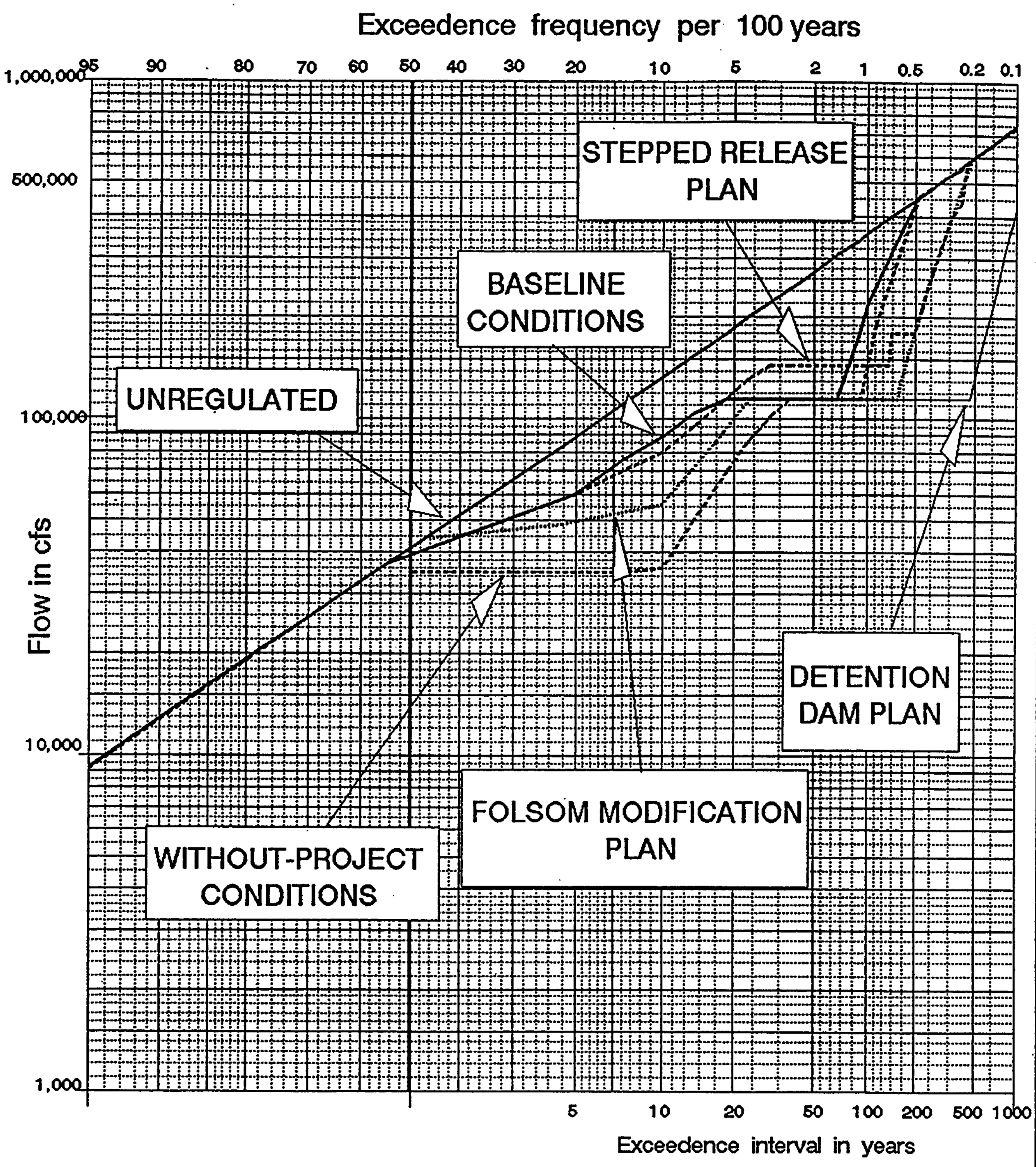
   b. Releases will not be increased more than 15,000 cfs or decreased more than 10,000 cfs during any 2 hour period.

AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

FOLSOM DAM AND RESERVOIR
VARIABLE SPACE FLOOD CONTROL DIAGRAM
400,000 - 670,000 acre feet

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

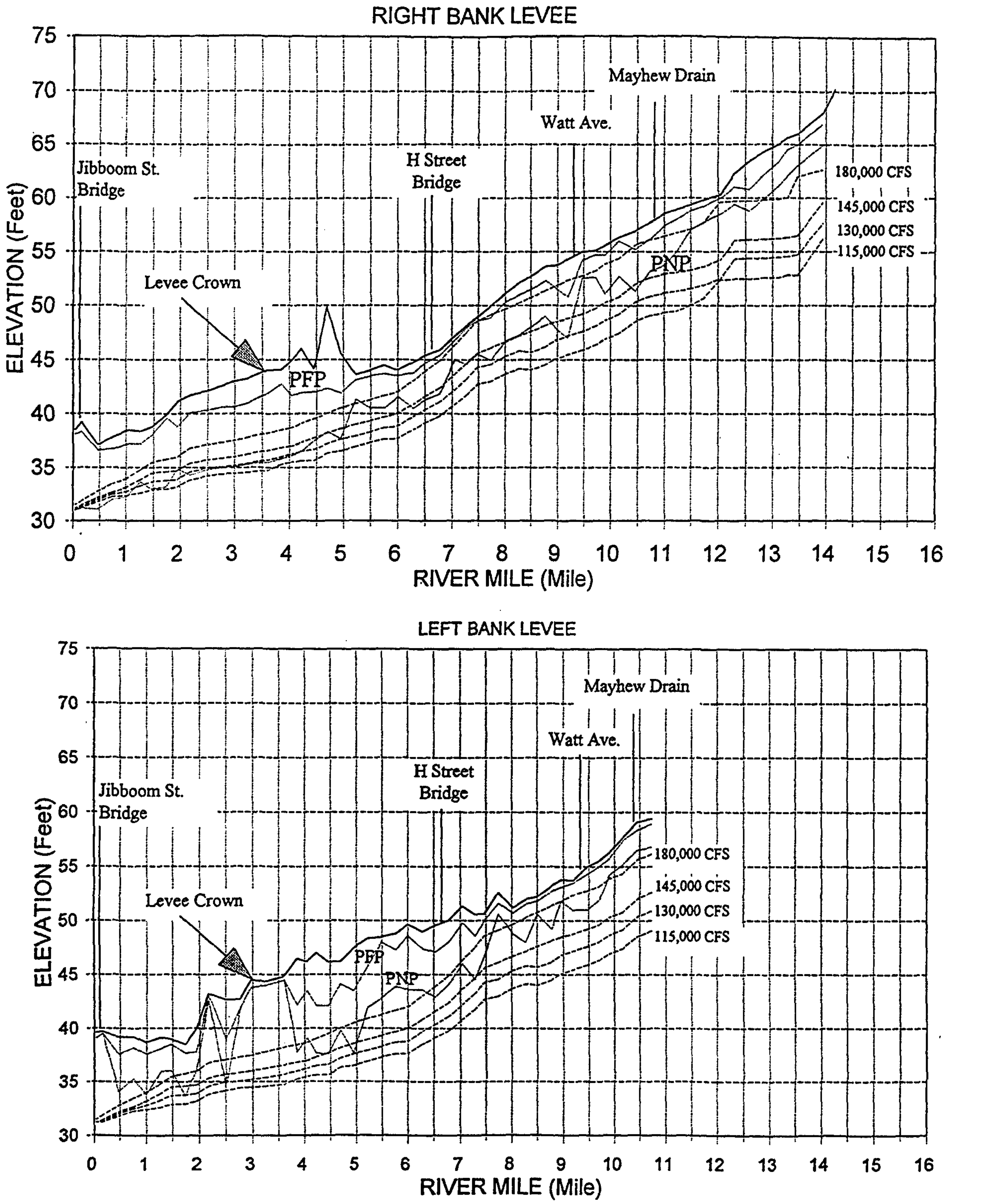
PLATE 3



AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

PEAK DISCHARGE FREQUENCY RELATIONSHIPS

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

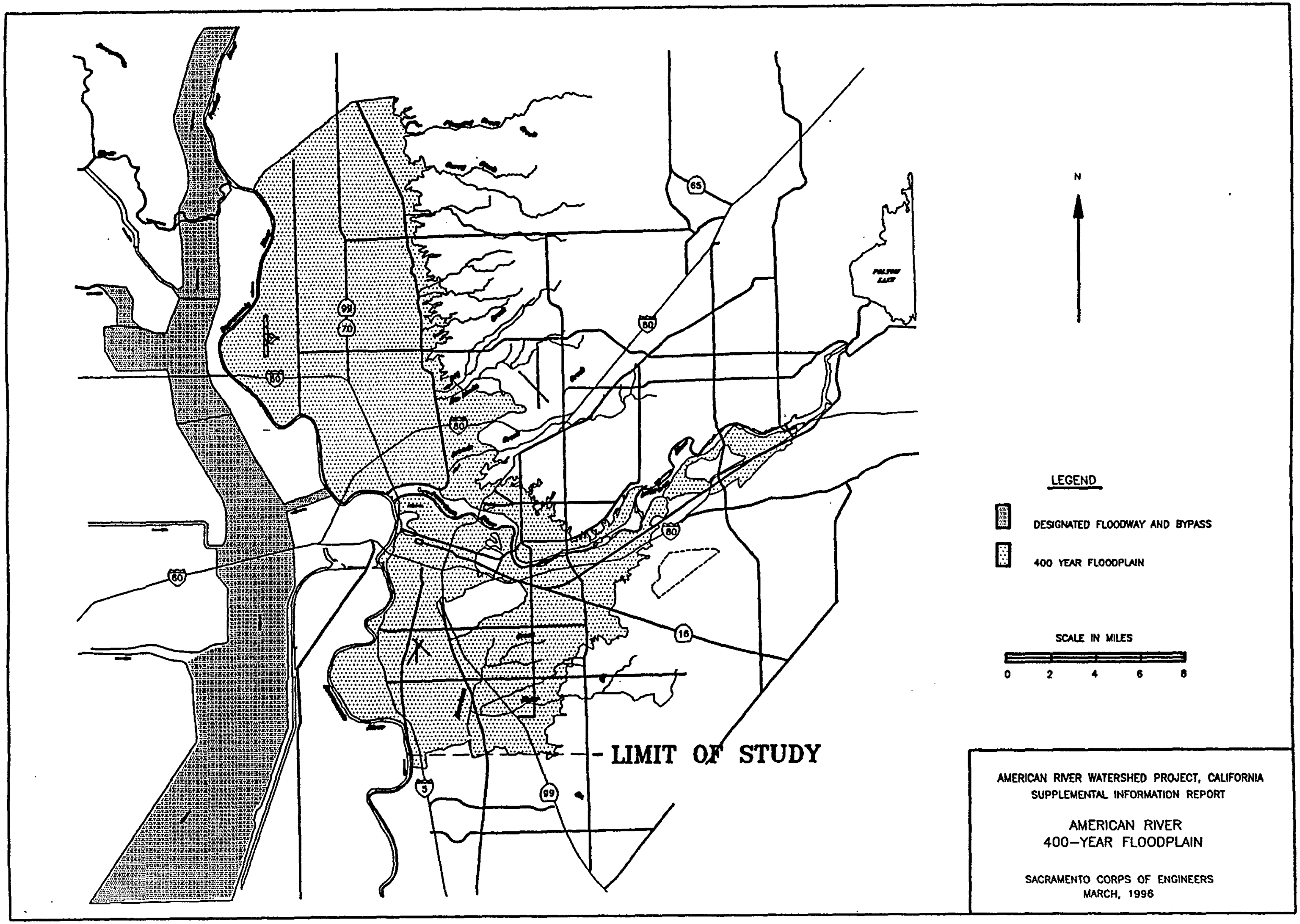


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

PFP, PNP, AND LOWER AMERICAN RIVER WATER SURFACE PROFILES

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

PLATE 5

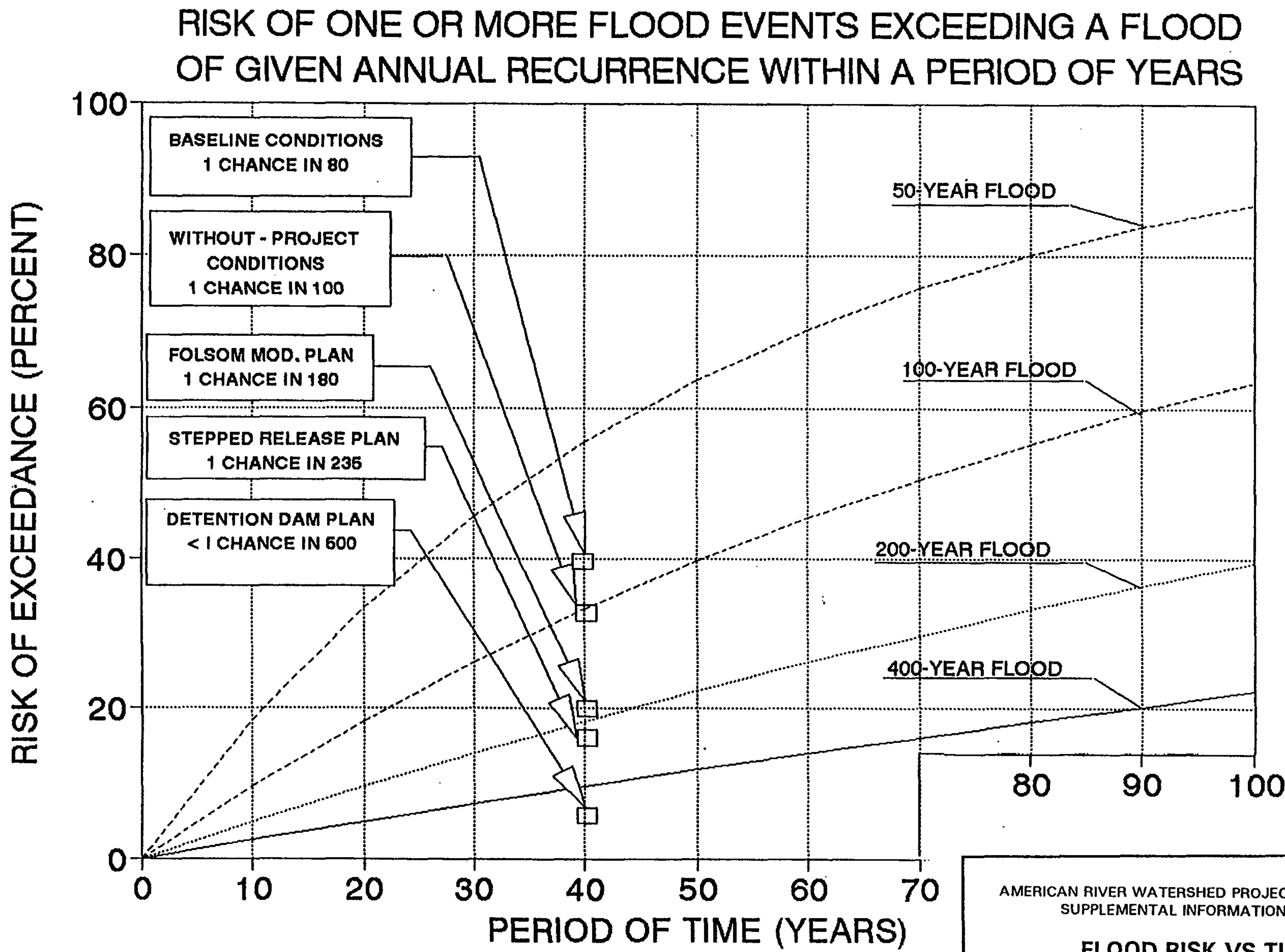


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

AMERICAN RIVER
400-YEAR FLOODPLAIN

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

PLATE 6

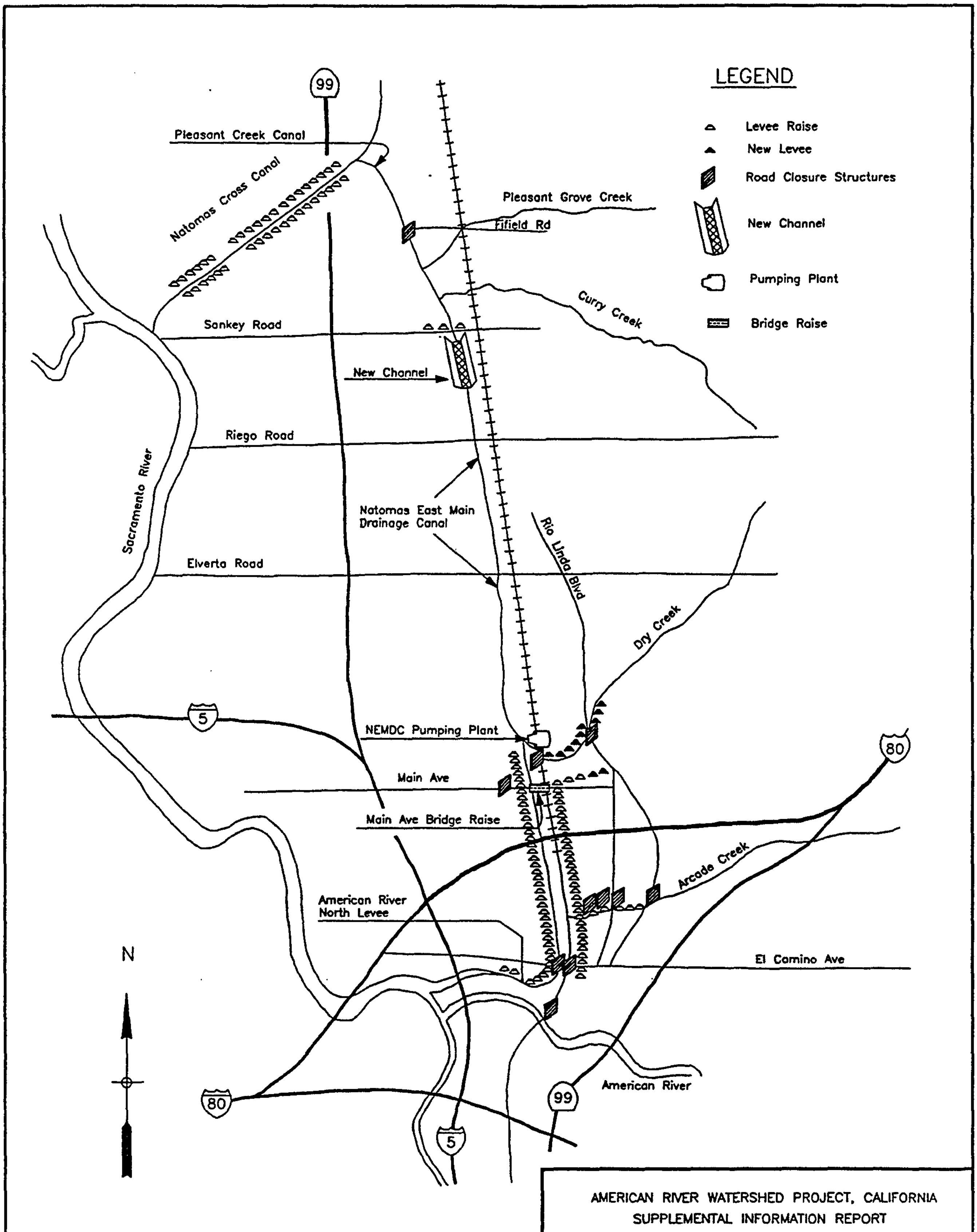


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

FLOOD RISK VS TIME

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

PLATE 7

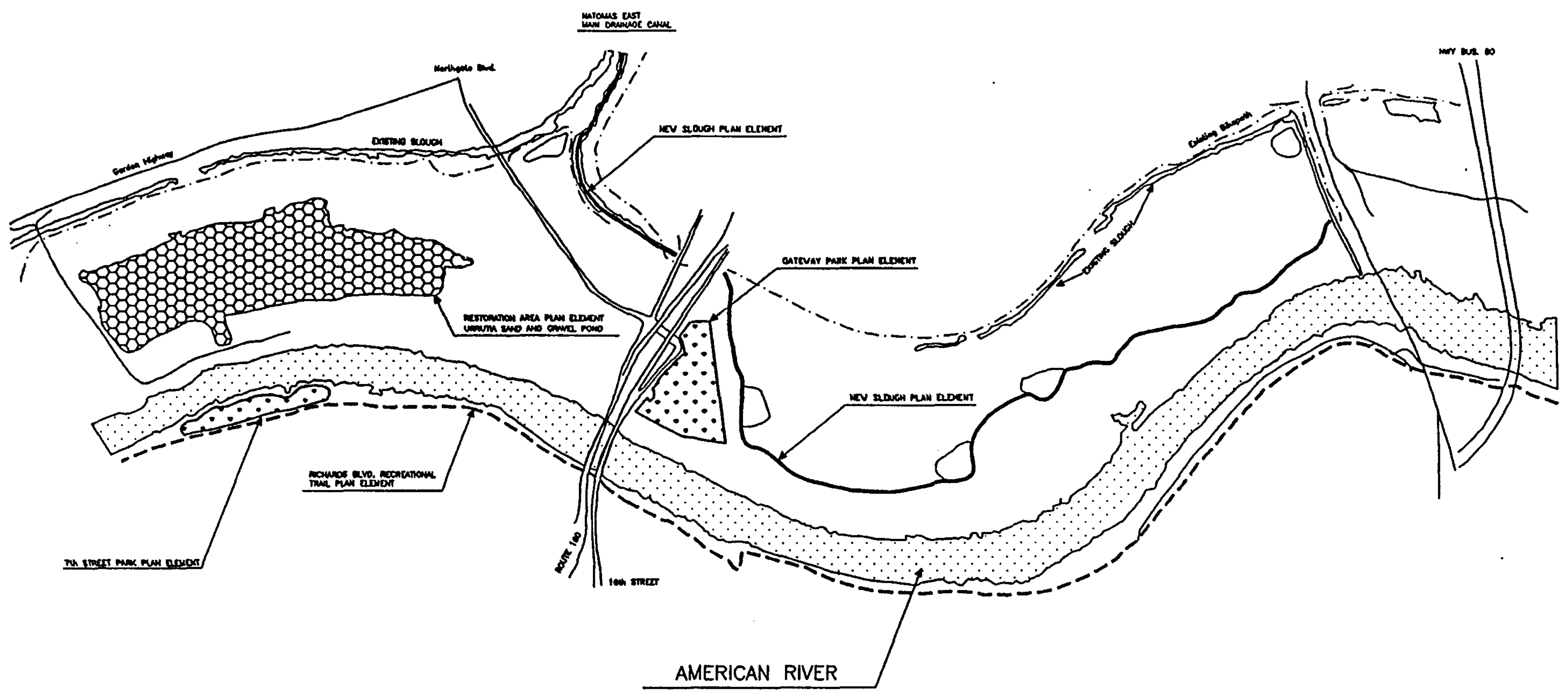


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

SAFCA NATOMAS
FLOOD CONTROL PROJECT

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

PLATE 8



LEGEND

- American River
- Park
- Gravel Pit
- Slough
- Bikepath

North

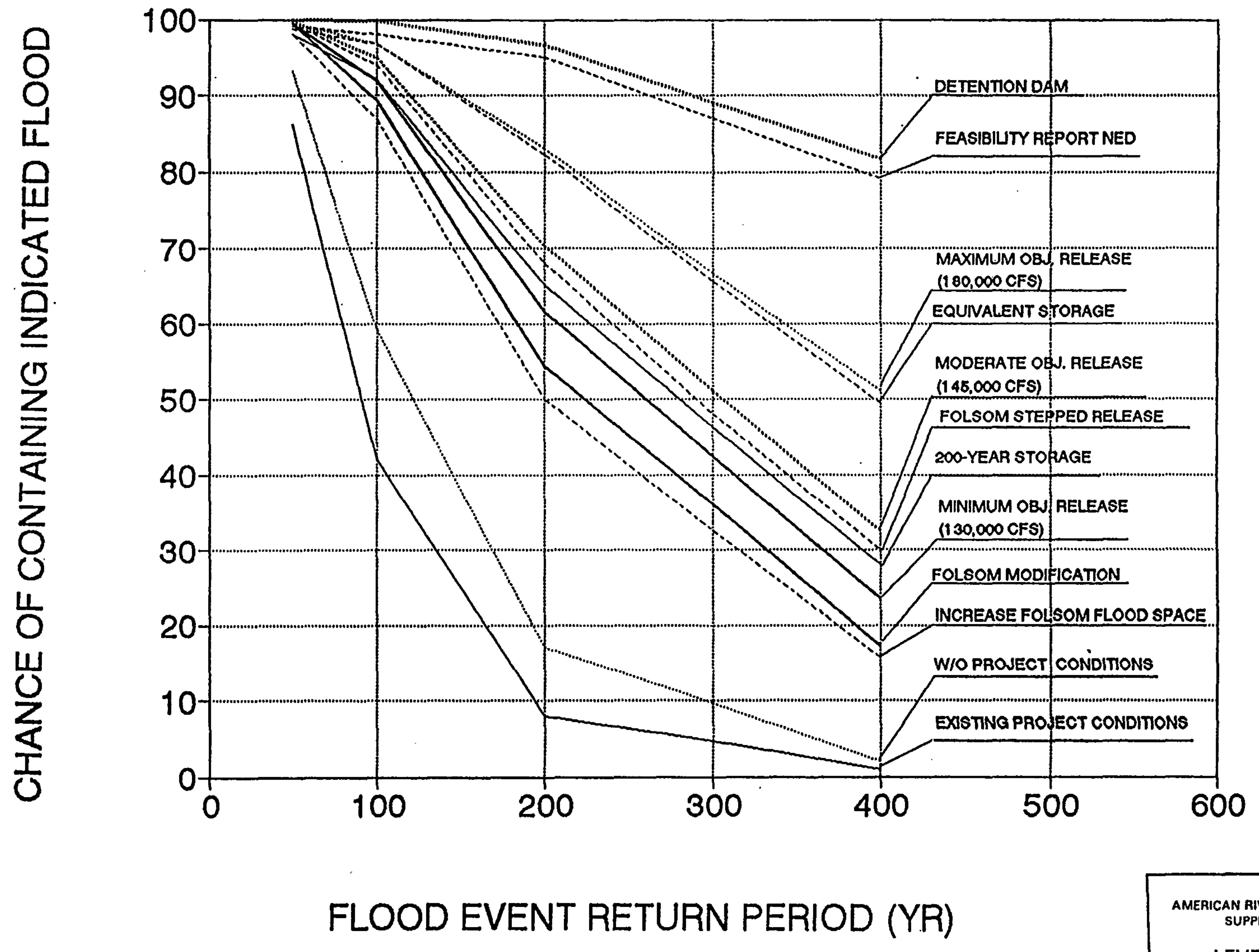
SCALE IN FEET
0 400 800

AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

RESTORATION AND RECREATION PLAN ELEMENTS

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

PLATE 9

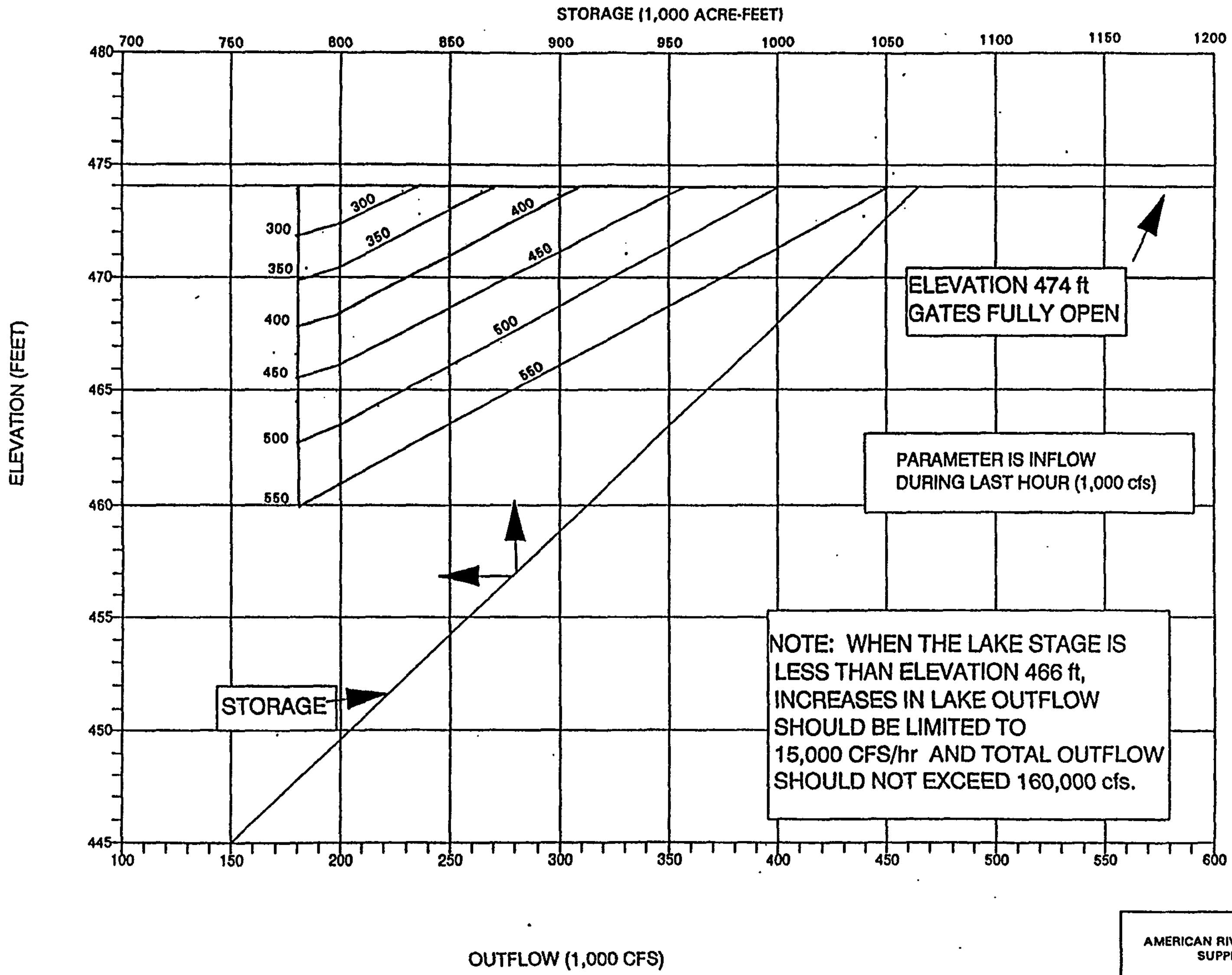


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

LEVEE SYSTEM RELIABILITY

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

PLATE 10

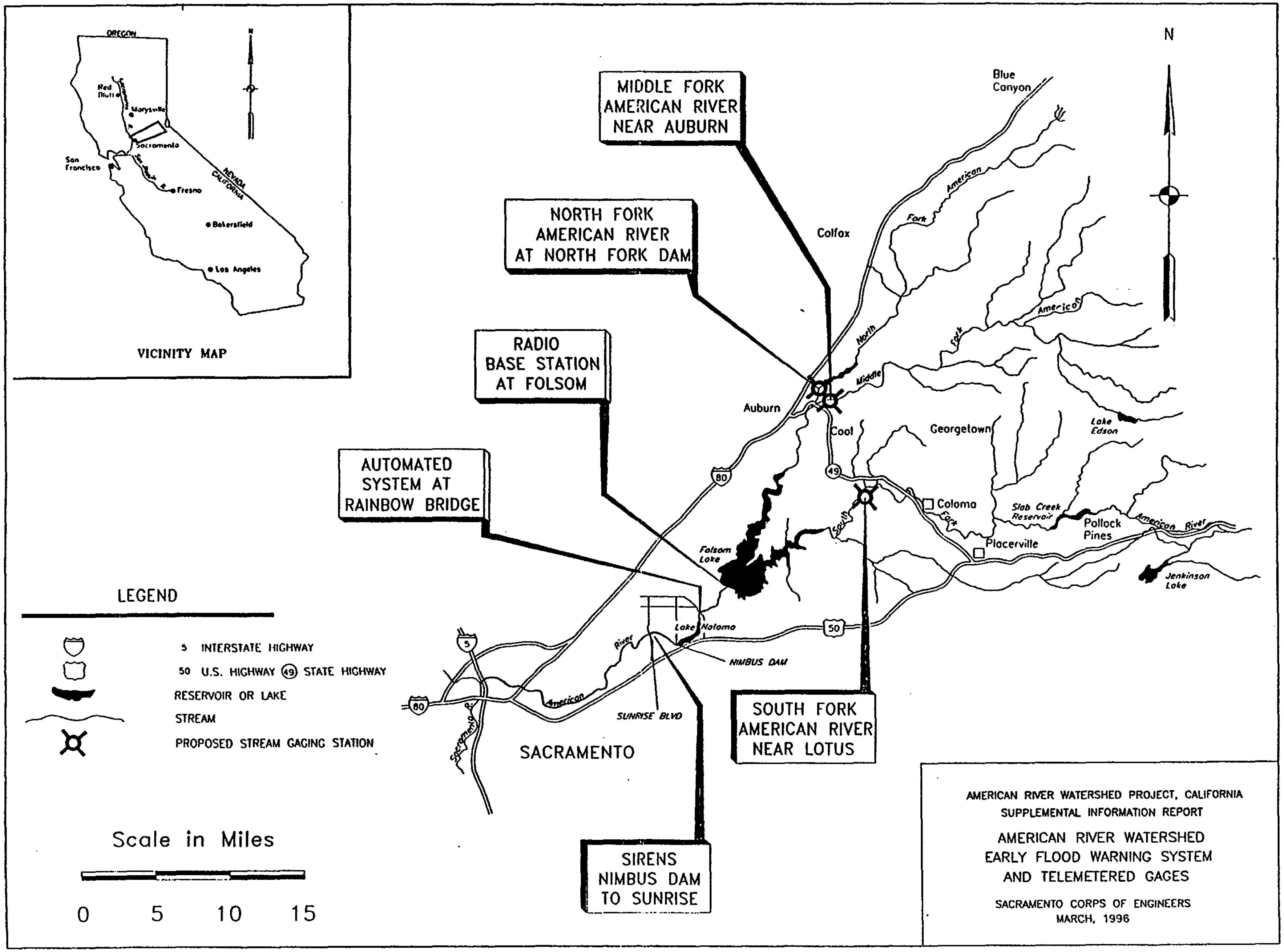


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

**FOLSOM DAM AND RESERVOIR
REVISED EMERGENCY SPILLWAY
RELEASE DIAGRAM (1995)**

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH, 1996

PLATE 11

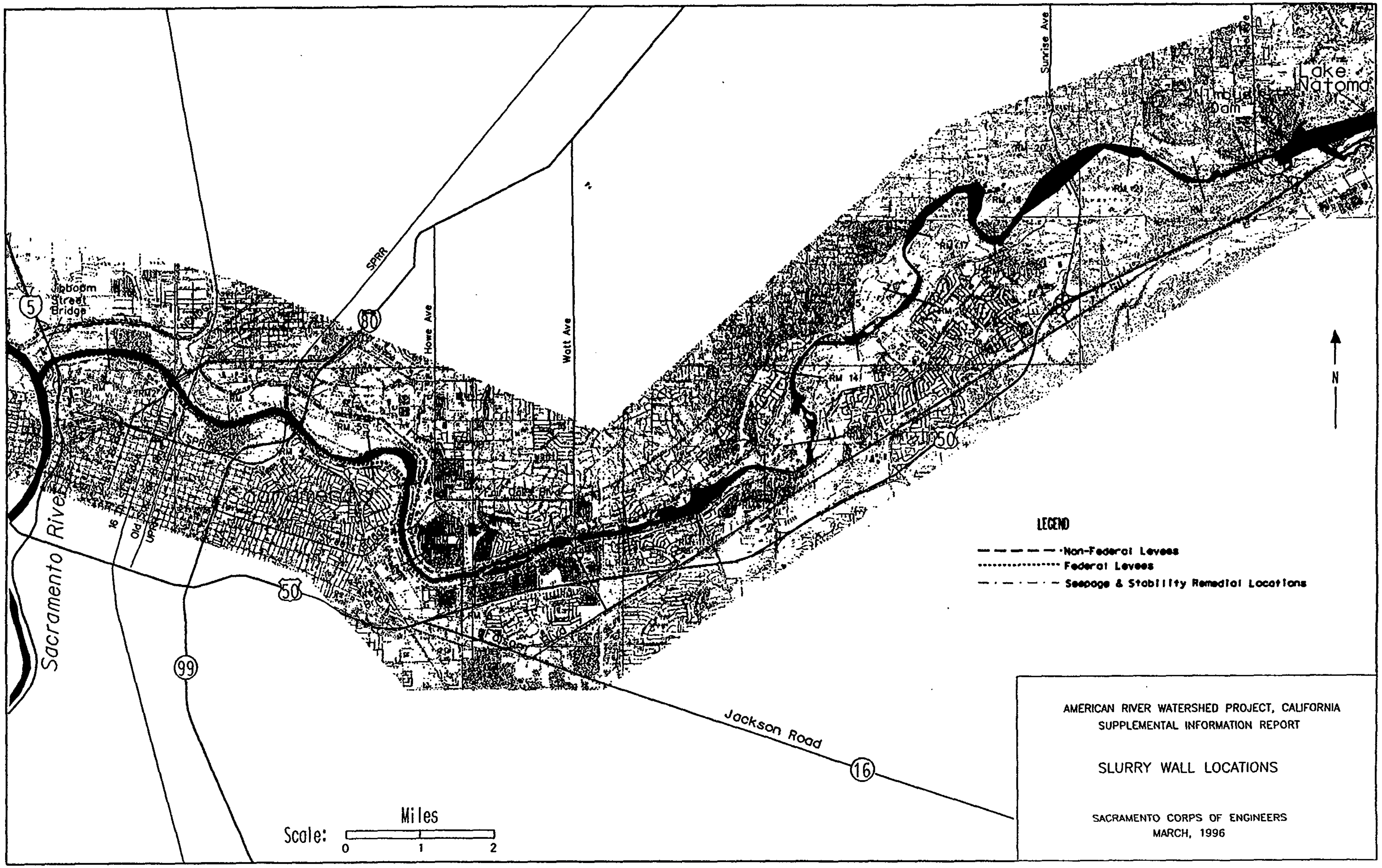


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

AMERICAN RIVER WATERSHED
EARLY FLOOD WARNING SYSTEM
AND TELEMETERED GAGES

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

PLATE 12

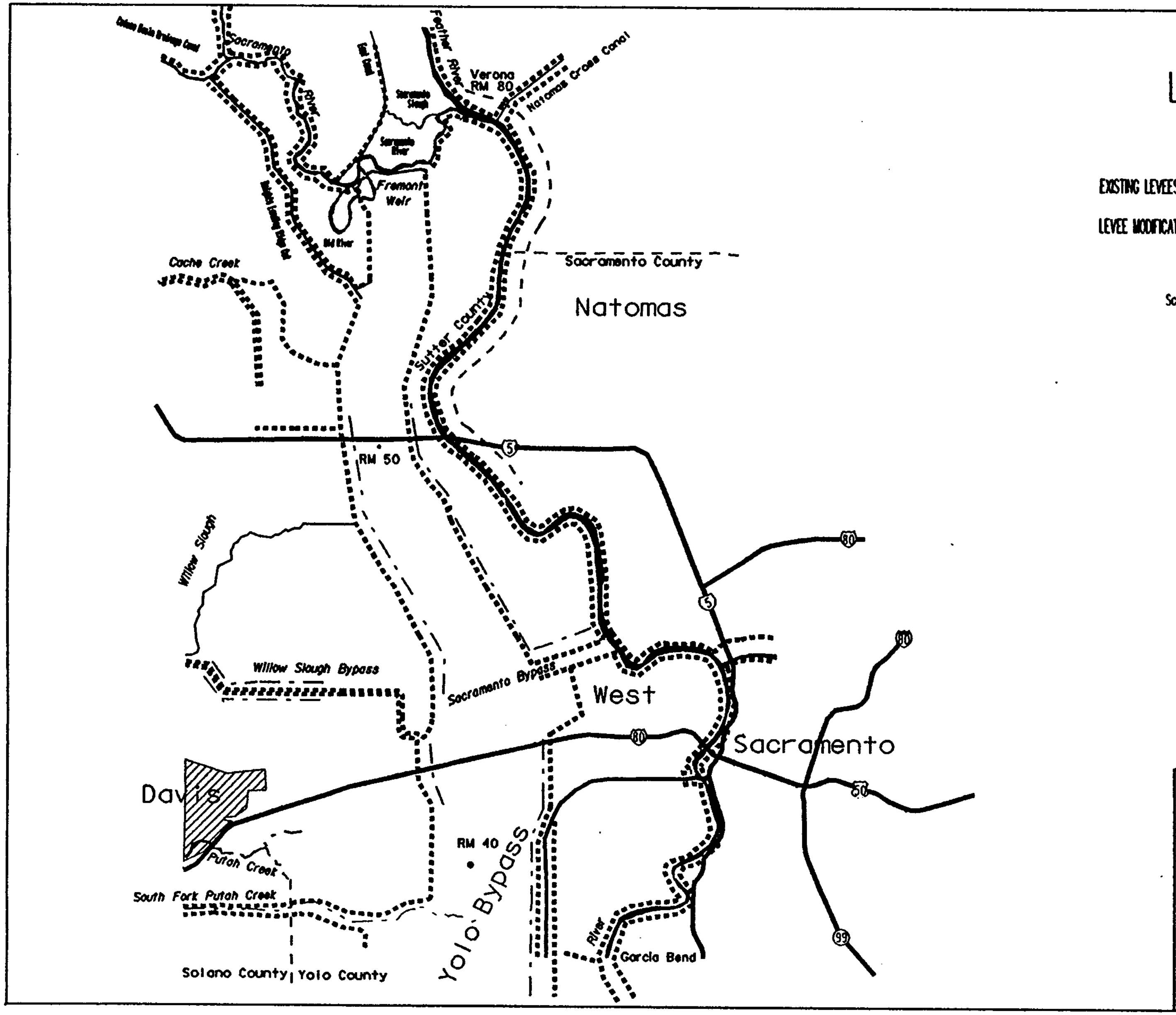


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

SLURRY WALL LOCATIONS

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

PLATE 13



AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPEMENTAL INFORMATION REPORT

NATOMAS LEVEE FEATURES

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH 1996

PLATE 14

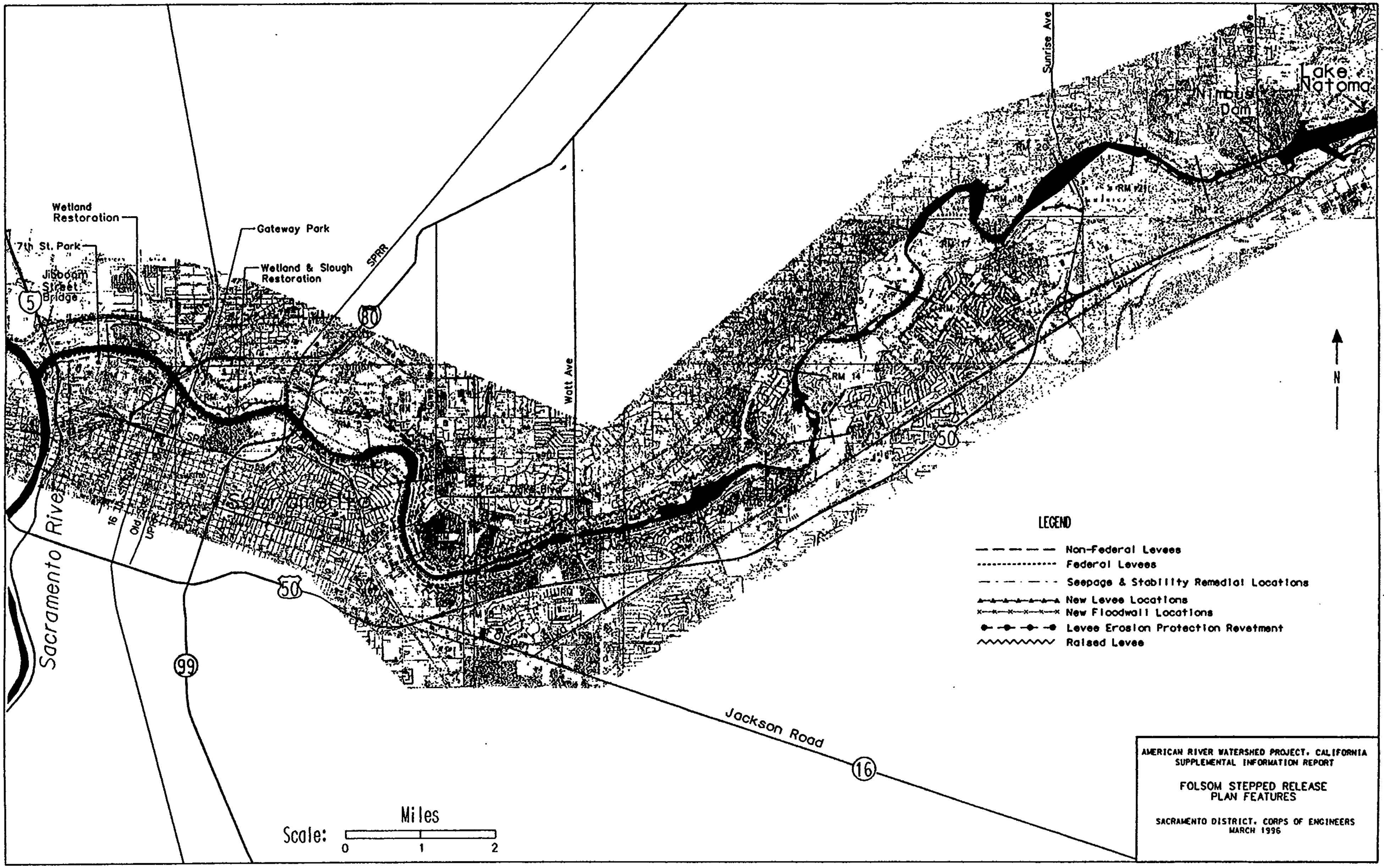
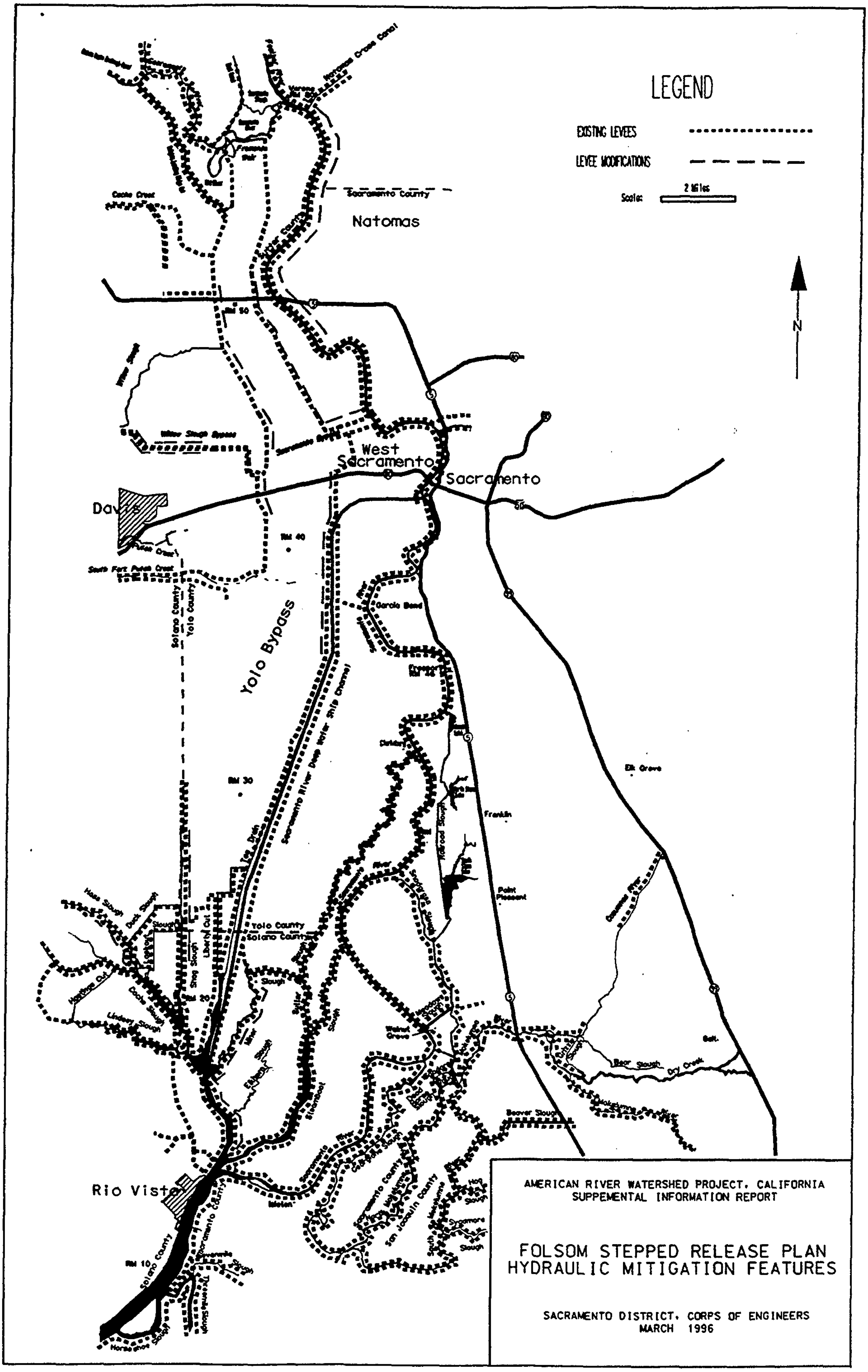

Wetland Restoration
7th St. Park
Jiboom Street Bridge
Gateway Park
Wetland & Slough Restoration
SPRR
80
5
Watt Ave
Sunrise Ave
Lake Natoma
Nimbus Dam
RM 14
RM 17
RM 20
RM 21
N
50
99
16
Jackson Road
Sacramento River
LEGEND
Non-Federal Levees
Federal Levees
Seepage & Stability Remedial Locations
New Levee Locations
New Floodwall Locations
Levee Erosion Protection Revetment
Raised Levee
Scale:
Miles
0
1
2
AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT
FOLSOM STEPPED RELEASE
PLAN FEATURES
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH 1996

PLATE 15



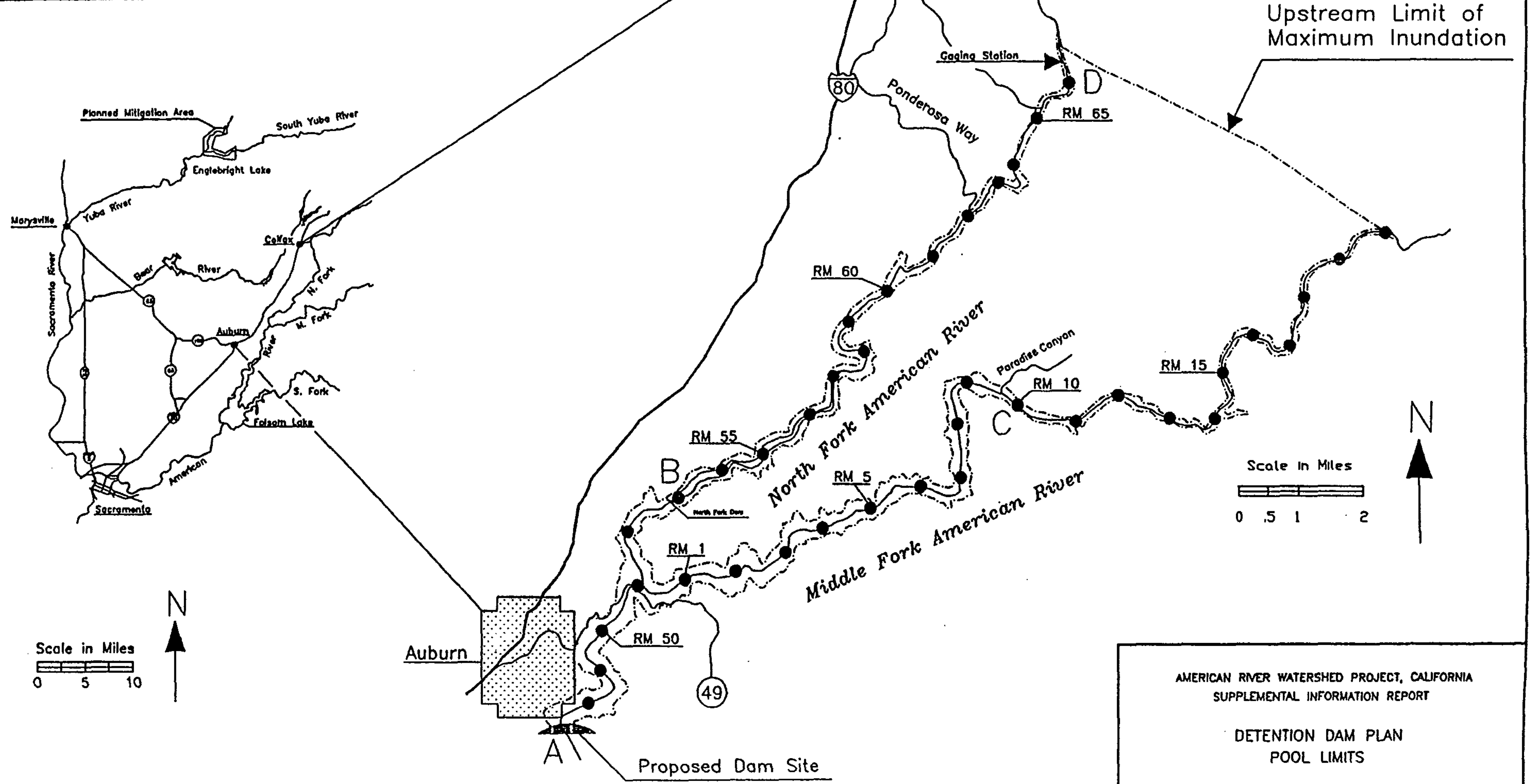
AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPEMENTAL INFORMATION REPORT

FOLSOM STEPPED RELEASE PLAN
HYDRAULIC MITIGATION FEATURES

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
MARCH 1996

PLATE 16

ITEM	MAXIMUM STORAGE	200 YEAR STORAGE	100 YEAR STORAGE	50 YEAR STORAGE	10 YEAR STORAGE
Storage (ac-ft)	894,000.00	634,889.00	444,650.00	232,725.00	23,915.00
Area (acres)	5,450.00	4,463.00	3,525.00	2,388.00	525 .00
Elev.(feet)	942.00	890.00	842.00	769.00	606.00
Miles Inundated	40.30	37.30	32.30	23.80	8.00
Flood (Yr)	400.00	200.00	100.00	50.00	10.00
Chance Occ.\Yr	0.25	0.50	1.00	2.00	10.00
Chance Occ.\100Yr	22.00	40.00	64.00	87.00	100.00
A Auburn Dam	452.00	400.00	352.00	279.00	118.00
B NF Dam	352.00	300.00	252.00	179.00	00.00
C Paradise	232.00	180.00	132.00	59.00	00.00
D Canyon near gaging station	30.00	00.00	00.00	00.00	00.00

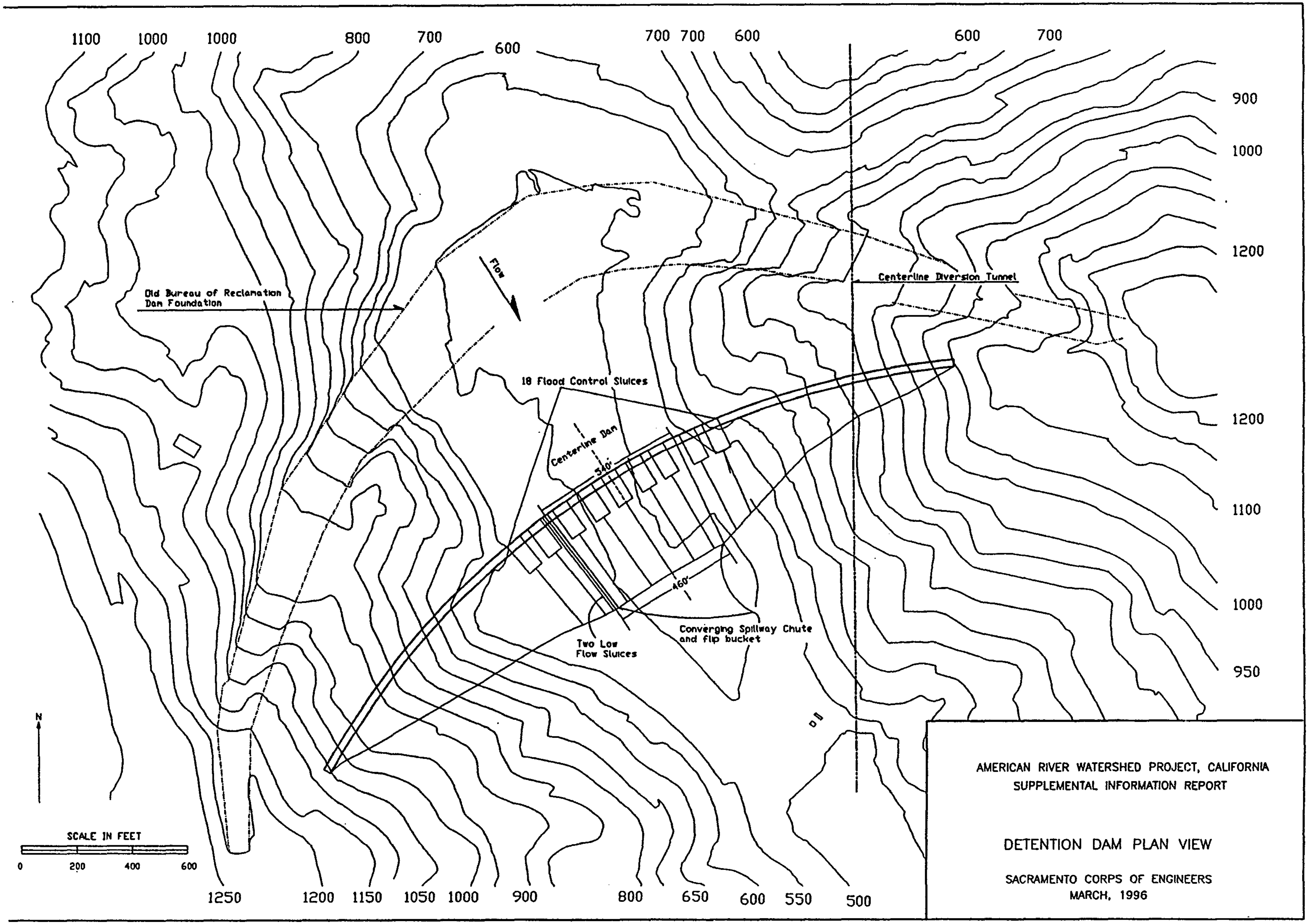


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

DETENTION DAM PLAN
POOL LIMITS

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

PLATE 17

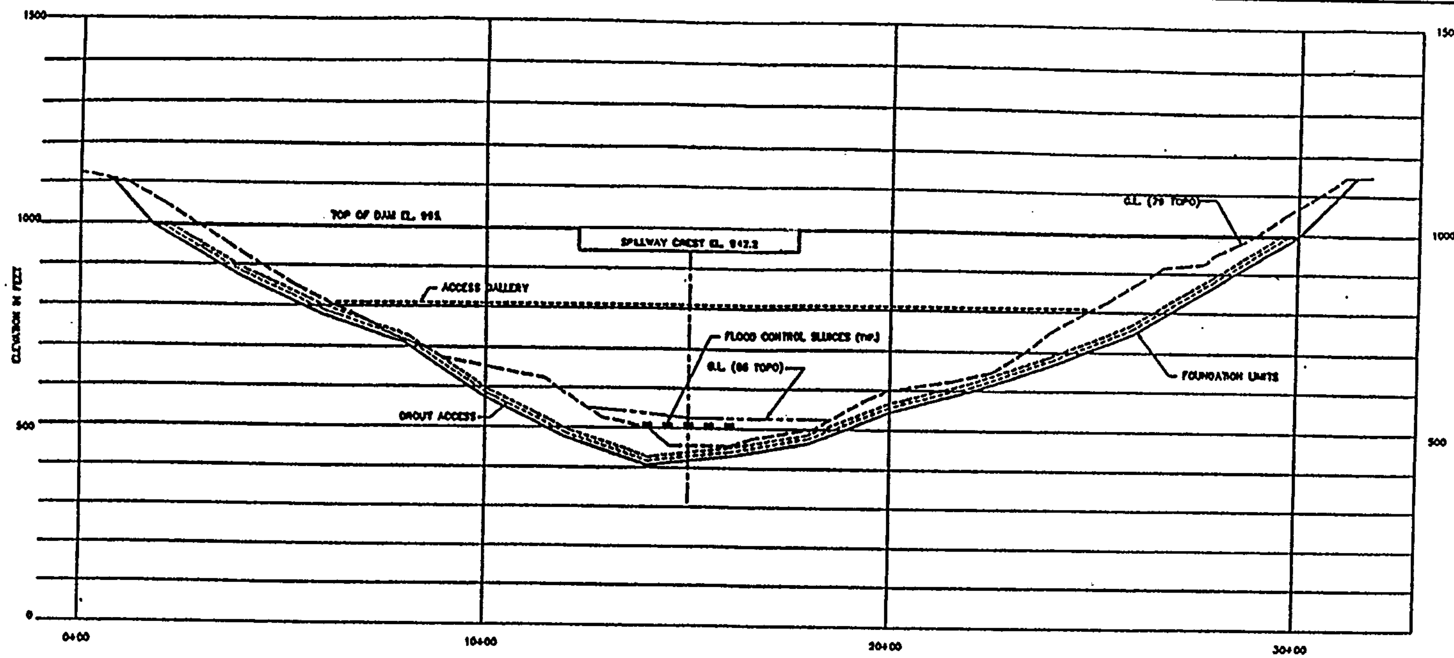


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

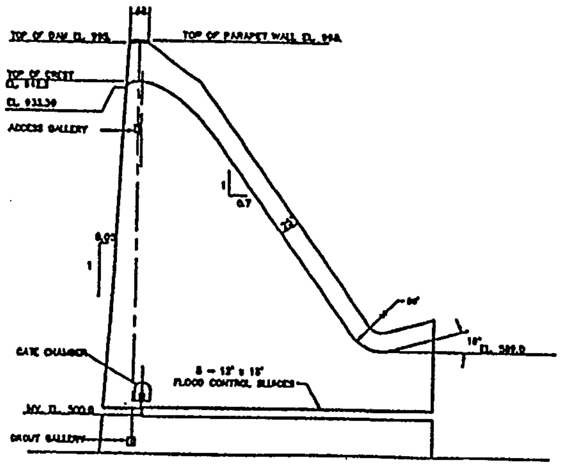
DETENTION DAM PLAN VIEW

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

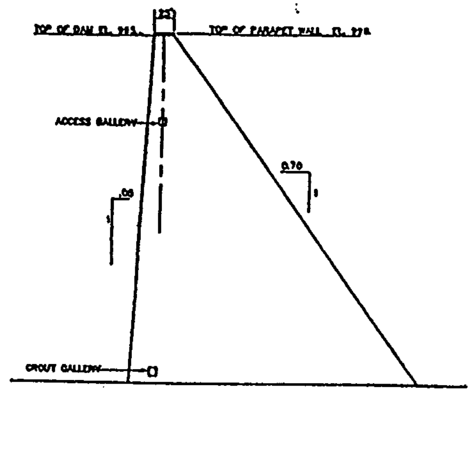
PLATE 18



PROFILE
SCALE: 1" = 100'



SPILLWAY SECTION

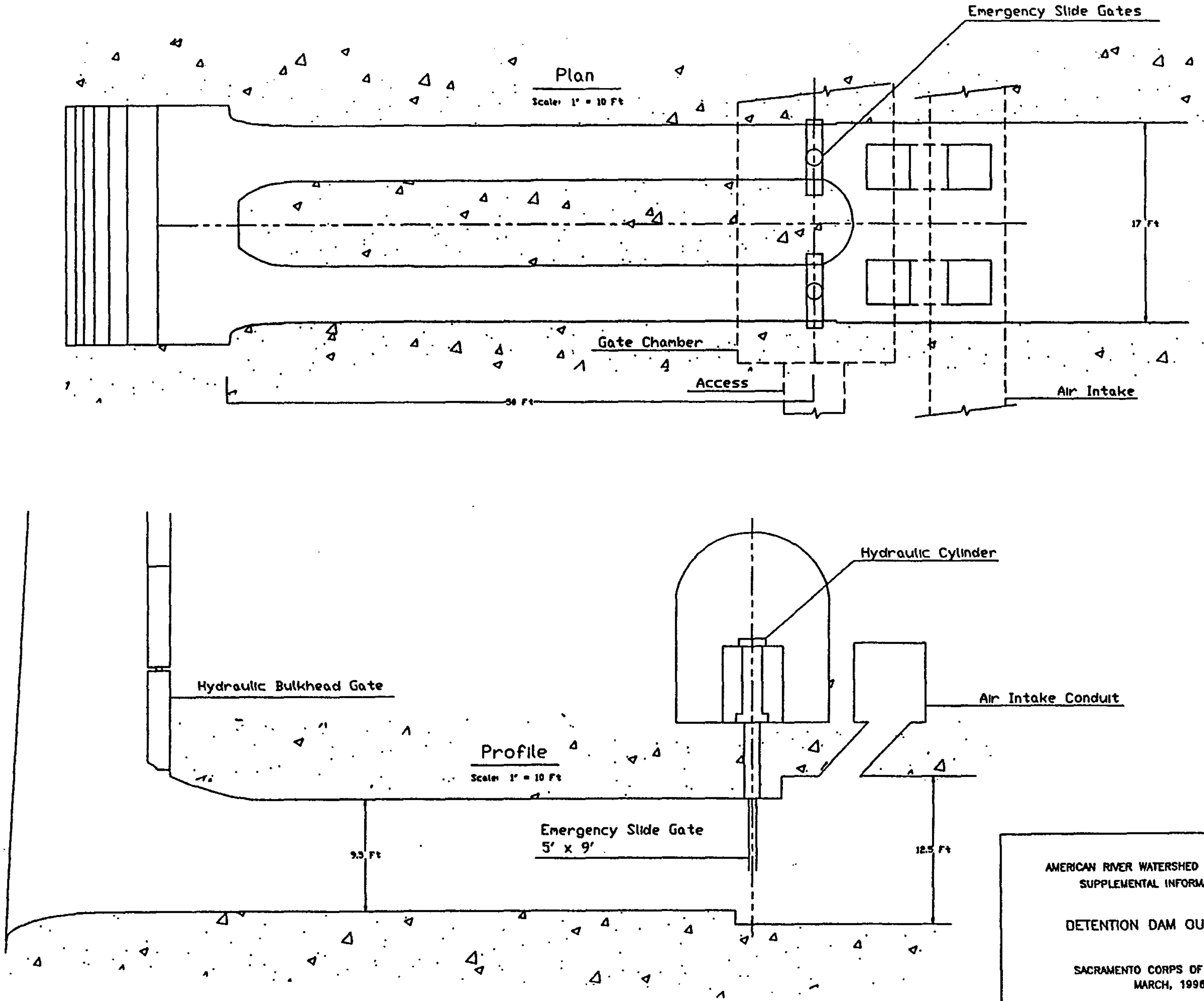


FLOOD CONTROL RCC DAM
NON-OVERFLOW SECTION

AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

DETENTION DAM PLAN
SPILLWAY AND SECTIONS

SCRAMENTO DISTRICT, CORPS OF ENGINEERS
AUGUST, 1995

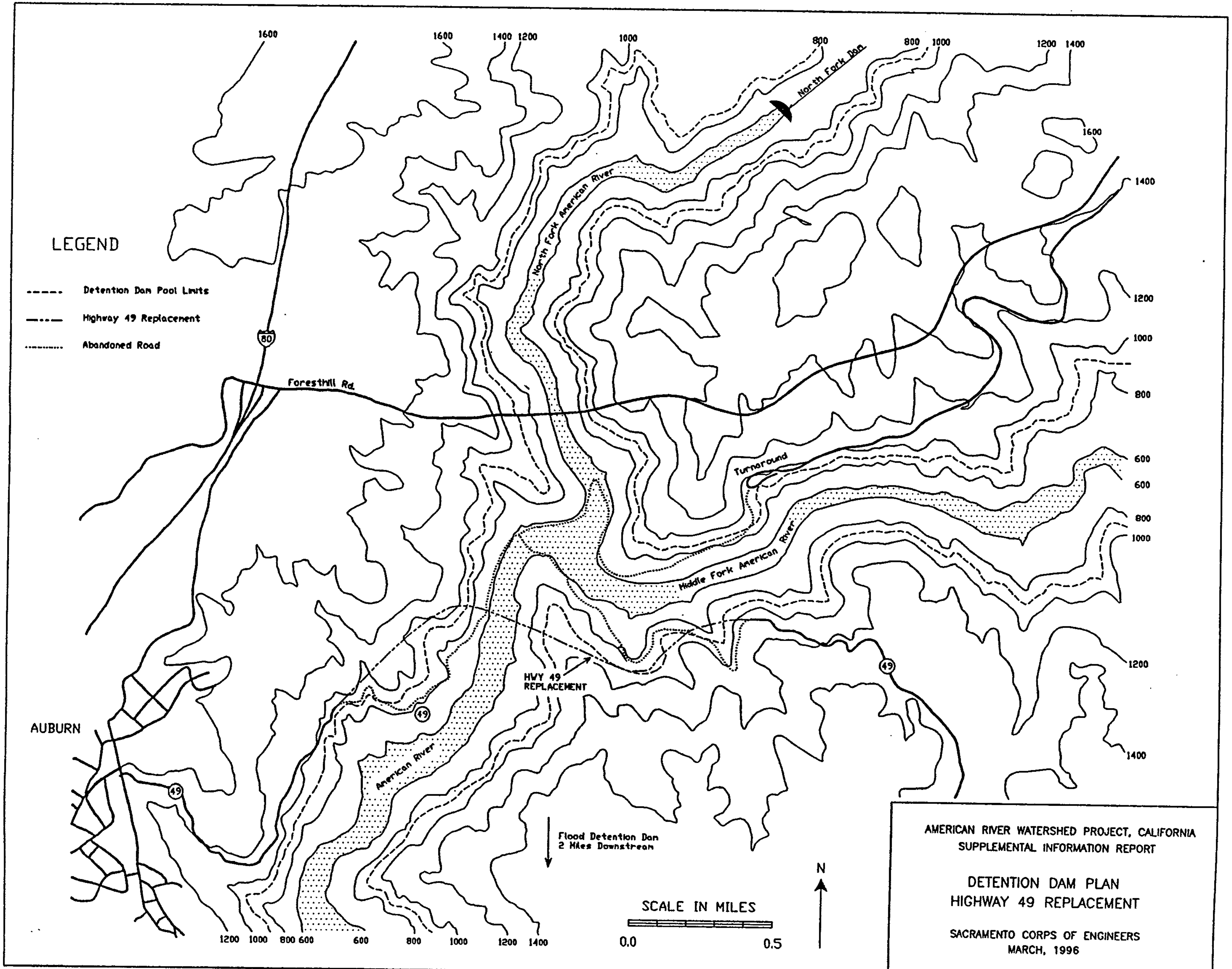


AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

DETENTION DAM OUTLET WORKS

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

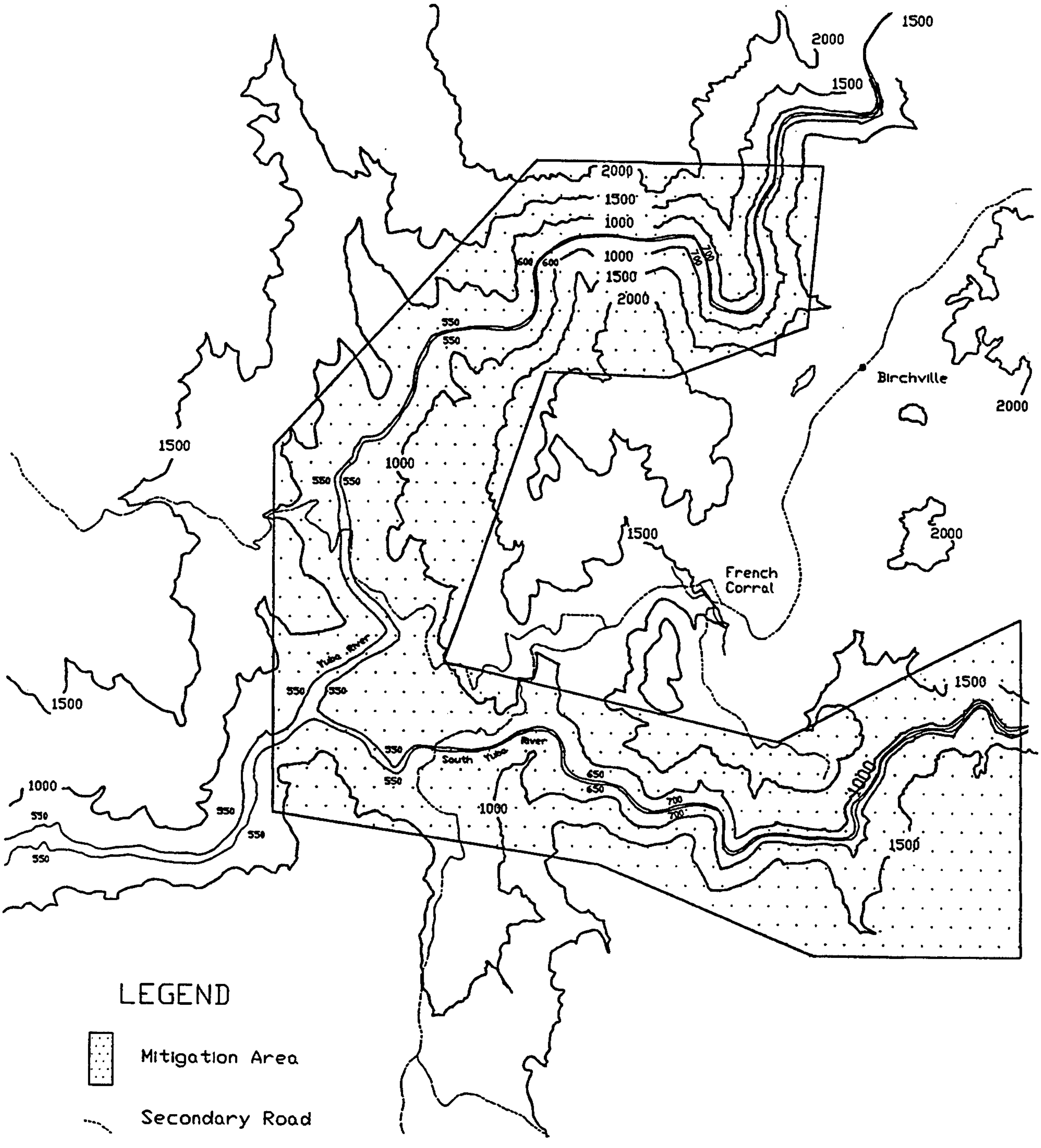
PLATE 20



AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

DETENTION DAM PLAN
HIGHWAY 49 REPLACEMENT

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996



LEGEND

Mitigation Area

Secondary Road

N

Scale in Feet

1000 0 1000 3000 5000 7000

AMERICAN RIVER WATERSHED PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT

DETENTION DAM
ENVIRONMENTAL MITIGATION AREA

SACRAMENTO CORPS OF ENGINEERS
MARCH, 1996

American River Watershed Project, California

Part II

Final Supplemental Environmental Impact Statement/ Environmental Impact Report

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT/ ENVIRONMENTAL IMPACT REPORT AMERICAN RIVER WATERSHED PROJECT SACRAMENTO, CALIFORNIA

March 1996

( ) Draft Environmental Impact Statement and Environmental Impact Report

(X) Final Supplemental Environmental Impact Statement and Environmental Impact Report

The responsible offices are: U.S. Army Engineer District, Sacramento, 1325 J Street, Sacramento, California 95814-2922, The Reclamation Board, State of California, 1416 9th Street, Room 455-6, Sacramento, California, 95814, and Sacramento Area Flood Control Agency, 1007 7th Street, 5th Floor, Sacramento, California, 95814-3407.

1. **Action:** ( ) **Administrative** (X) **Legislative**

2. **Purpose**: The purpose of this Final Supplemental Environmental Impact Statement and Environmental Impact Report (SEIS/EIR) is to present environmental impacts and mitigation data and solicit comments from interested parties. Comments will be used by reviewers at the Office of the Chief of Engineers; the Office of the Assistant Secretary of the Army (Civil Works); the Office of Management and Budget; and ultimately by Congress to assist in making decisions concerning the authorization of this project.

3. **Abstract**: This final SEIS/EIR analyzes the potential environmental and related impacts associated with the Detention Dam Plan to increase flood protection to the Sacramento area. This Plan would reduce the probability of flooding to less than 1 chance in 500 in any given year. This plan consists of (1) constructing a 508-foot-high roller compacted concrete dam near Auburn that could temporarily impound a total of 894,000 acre-feet of water, (2) constructing 24 miles of slurry wall in the levees along the lower American River, and (3) raising and stabilizing 12 miles of Sacramento River levees in Natomas. About 1,682 acres of vegetation would be lost due to construction and operation of this plan. The selected plan would have adverse impacts on vegetation and wildlife and other resources of the American River near Auburn. Mitigation is proposed to compensate for the adverse impacts which would result from constructing and operating the project. The proposed Federal project will be sponsored by the State of California and Sacramento Area Flood Control Agency, which will cost-share in its construction and operate and maintain the completed project. The first cost of the project is currently estimated at $934 million.

This final SEIS/EIR has been prepared to fulfill the requirements of the National Environmental Policy Act, the California Environmental Quality Act and all other applicable laws and statutes. The overall analysis considered an array of alternative plans to meet the primary planning objective of improving flood protection for the City of Sacramento while avoiding or minimizing adverse environmental and related impacts to the maximum extent practicable. This document has identified the Detention Dam as the Selected Plan. The Detention Dam Plan meets the Section 404(b)(1) guidelines of the Clean Water Act, and an exemption under Section 404(r) of Public Law 92-500, as amended, is requested.

If your need further information, please contact Mike Welsh at (916) 557-6718.

CONTENTS

CHAPTER 1 - SUMMARY

CHAPTER 2 - PURPOSE OF AND NEED FOR ACTION

CHAPTER 3 - ALTERNATIVES

CHAPTER 6 - ENVIRONEMTNAL CONSEQUENCES - NO-ACTION ALTERNATIVE

CHAPTER 7 - ENVIRONMENTAL CONSEQUENCES- FOLSOM MODIFICATION PLAN

CHAPTER 9 - ENVIRONMENTAL CONSEQUENCES

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CHAPTER 12 - LIST OF PREPARERS

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CHAPTER 14 INTENDED USES OF FINAL SEIS/EIR

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

AAHU	average annual habitat unit
ac-ft	acre-feet
APCD	air pollution control district
ARB	State Air Resources Board
ARWI	American River Watershed Investigation
ARWRI	American River Watershed Resources Investigation
ASPIS	California Abandoned Sites Program Information System
ASRA	Auburn State Recreation Area
bfe	base flood elevation
BLM	Bureau of Land Management
CAR	Coordination Act Report
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CNDDB	California Natural Diversity Data Base
CO	carbon monoxide
COA	Coordinated Operations Agreement
CSUS	California State University, Sacramento
CVP-OCAP	Central Valley Project Operations Criteria and Plan
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	California Waterfowl Association
°F	degree Fahrenheit
Db	decibel
DBA	decibel (a-weighted sound level)
DO	dissolved oxygen
DPR	California Department of Parks and Recreation
DSEIR	draft supplemental environmental impact report
DSEIS	draft supplemental environmental impact statement
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
EDCAPCD	El Dorado County Air Pollution Control District
EDF	Environmental Defense Fund
EID	El Dorado Irrigation District
EIR	environmental impact report

EIS	environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FC1	Federal Category 1
FC2	Federal Category 2
FEMA	Federal Emergency Management Agency
FESA	Federal Endangered Species Act
FWS	Fish and Wildlife Service
GDPUD	Georgetown Divide Public Utility District
Gwh	gigawatthours
HEP	habitat evaluation procedures
HSI	habitat suitability index
HTW	hazardous and toxic waste
ITA	Indian Trust Asset
L_{dn}	day-night average level
los	level of service
M.F.	middle fork
MSA	metropolitan statistical area
msl	mean sea level
MW	megawatts
Mwh	megawatthours
NAAQS	national ambient air quality standards
NED	national economic development
NEMDC	Natomas East Main Drainage Canal
NEPA	National Environmental Policy Act
N.F.	north fork
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRA	national recreation area
NRCS	Natural Resource Conservation Service (formerly Soil Conservation Service)
NRHP	National Register of Historic Places
PCAPCD	Placer County Air Pollution Control District
PCWA	Placer County Water Agency
PFP	probable failure point
PG&E	Pacific Gas and Electric Company
PNP	probable nonfailure point
PROSIM	PROject SIMulation
PRC	project review conference
QWEST	flow west
RDF	reservoir design flood
RM	river mile
ROG	reactive organic gases

S.F.	south fork
SAFCA	Sacramento Area Flood Control Agency
SAFCASIM	Sacramento Area Flood Control Agency simulation
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SJWD	San Juan Suburban Water District
SMAQMA	Sacramento Metropolitan Air Quality Management Area
SMUD	Sacramento Municipal Utility District
SPRR	Southern Pacific Railroad
SR	state route
SRA	shaded riverine aquatic
SRFCP	Sacramento River Flood Control Project
SWP	State Water Project
SWRCB	State Water Resources Control Board
UPRR	Union Pacific Railroad
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
WRDA	Water Resources Development Act

LETTER SYMBOLS FOR UNITS OF MEASURE

cfs	cubic foot per second
dB	decibel
°F	degree Fahrenheit
gWh	gigawatthour
km	kilometer
kWh	kilowatthour
mg/l	milligrams per liter
Mgal/d	million gallons per day
mi	mile
ml	milliliter
pH	hydrogen ion concentration
ppm	parts per million
ug/l	micrograms per liter

CHAPTER 1

SUMMARY

INTRODUCTION

This supplemental environmental impact statement and environmental impact report was prepared jointly by the sponsors of the ARWP (American River Watershed Project): the Corps, California DWR (Department of Water Resources) and The Reclamation Board as the State lead agencies, and SAFCA (Sacramento Area Flood Control Agency) as the local lead agency. This document was prepared to satisfy both Federal and State environmental reporting requirements, pursuant to NEPA (National Environmental Policy Act) and the Council on Environmental Quality implementing regulation Section 40 CFR 1506.2(b), and Section 21083.5 of the California Environmental Quality Act. The information contained in the December 1991 Final Environmental Impact Statement/Environmental Impact Report, American River Watershed Investigation, and its appendixes is incorporated by reference and should be considered when reviewing this report. This chapter briefly explains the purpose of and need for action; the alternatives considered, including the selected plan; the effects of these alternatives on the environment and the measures needed to mitigate these effects; the areas of controversy associated with the project; and the issues which remain unresolved at this stage in the planning process.

PURPOSE OF AND NEED FOR ACTION

Sponsors of the ARWP are seeking to develop and implement a plan of flood control improvements that would significantly increase the level of protection provided to the Sacramento area from flooding along the main stem of the American River. The purpose of this document is to consider the environmental effects in the decisionmaking process and provide full disclosure of these effects to the public. The minimum objective of the State and SAFCA is to provide the area with protection from a storm with a 1 in 200 chance of occurring in any year, the minimum protection considered appropriate by these agencies for a heavily urbanized area with hundreds of thousands of residents and billions of dollars of property at risk from an uncontrolled flood. The Corps' objective is to provide increased flood protection consistent with applicable Federal planning principles and guidelines which focus on identifying and providing Federal financial assistance for the plan which maximizes national economic development while protecting the Nation's environment (NED Plan). The NED Plan is the plan which provides the maximum net economic benefits as measured by average annual flood damages avoided less average annual costs. The NED Plan is identified in this final SEIS/EIR.

DESCRIPTION OF THE PROBLEM

Action is needed to address the flood risk to Sacramento. The risk was exposed during the flood of February 1986 when record inflows to Folsom Reservoir compelled reservoir operators to make releases into the lower American River channel in excess of the safe carrying capacity of the channel. Although the storm abated without a major levee failure, a slightly larger storm would have resulted in uncontrolled flooding, threatening up to about 400,000 residents and nearly $37 billion in damageable property in the American River flood plain. Direct structure-inundation damages from levee failure during a 400-year storm would be about $16 billion.

In the aftermath of this flood, the 1987 Appropriations Act authorized the Corps to initiate the American River Watershed Investigation. During the reconnaissance phase of this study, the Corps reassessed the hydrology of the American River watershed and concluded that, under existing conditions, Sacramento could experience uncontrolled flooding in the event of about a 70-year or greater storm. Based on this assessment, the Corps identified potentially feasible alternatives for increasing the capacity of the existing flood control system and recommended initiation of a feasibility-level investigation to provide a more detailed analysis of Sacramento's flood problems and solutions.

AMERICAN RIVER WATERSHED PROJECT (ARWP)

In July 1988, the Continuing Appropriations Act (Public Law 100-202) authorized the Corps to commence the feasibility phase of the American River Watershed Investigation on a cost-shared basis with the State of California. The State in turn entered into an arrangement with local agencies interested in the project to act as local sponsors. These agencies subsequently created SAFCA, a joint power authority, to represent local interests in the planning process.

In April 1991, the Corps published a draft feasibility report and EIS/EIR which identified the 400-year alternative, a flood detention dam near Auburn capable of storing up to 894,000 acre-feet of floodwater, as the NED Plan. In June 1991, SAFCA and The Reclamation Board jointly requested that the Corps pursue the 200-year alternative, a scaled-down version of the NED Plan, consisting of a flood detention dam at Auburn capable of storing up to 545,000 acre-feet of floodwater. In December 1991, the Corps Sacramento District published a final feasibility report and EIS/EIR which described this 200-year alternative.

For a variety of procedural and substantive reasons, Congress declined to authorize the locally preferred plan in 1992, leaving the area susceptible to flooding. Instead, in language set forth in Section 9159 of the Department of Defense Appropriations Act for Fiscal Year 1993 (Public Law 102-396), the Natomas features described in the feasibility report were authorized; in subsequent Congressional correspondence, the Corps was directed to reevaluate Sacramento's flood control options and provide (1) additional information on

the gating and expandability features of the flood detention dam, (2) a more detailed analysis of the costs and benefits of modifying Folsom Dam, improving the efficiency of flood control operations at Folsom, and increasing the conveyance capacity of the American River levee system; (3) information on transfer of flood control space to an upstream facility; (4) a description of the effects of using existing and increased flood space in upstream reservoirs; and (5) a reassessment of the costs and benefits of enlarging Folsom Reservoir or, alternatively, establishing offstream storage capacity along Deer Creek in the Cosumnes River watershed.

ACTIONS TAKEN SINCE 1992

The following actions taken after the 1992 legislative session have affected the scope and character of the Corps response to Congress' call for a reevaluation of the American River project: (1) initiation of SAFCA's construction of the Natomas features of the project with local funds (SAFCA Local Project); (2) execution of a 5-year agreement between SAFCA and Reclamation (U.S. Bureau of Reclamation) to modify the operation of Folsom Reservoir (Interim Reoperation); (3) initiation of a bank protection project affecting up to 13,800 linear feet along critical reaches of the lower American River (Sacramento River Bank Protection Project—Lower American River Phase); (4) initiation of a regional water study, the ARWRI (American River Water Resources Investigation) by Reclamation in conjunction with Sacramento, Placer, El Dorado, and San Joaquin Counties; and (5) initiation of repairs on the failed gate at Folsom Dam. These actions and their effect on the Corps plan formulation process are discussed in chapter 2.

ALTERNATIVES REPORT

In November 1994, the Corps took the first step in the ARWP reevaluation by issuing an Alternatives Report designed to address the issues raised by Congress in Public Law 102-396. The Alternatives Report confirmed the essential conclusions of the 1991 final report; accounted for the governmental actions taken since 1992; and reevaluated the alternatives presented in the report based on a new method of accounting for uncertainties in predicting the pattern of precipitation and runoff in the watershed, the operation of Folsom Dam during flood events, and the performance of the downstream levee system. These results are more fully explained in chapter 2. Following issuance of the Alternatives Report, the State and SAFCA reassessed their recommendations with respect to the project and requested the Corps to focus its review on the Detention Dam and Stepped Release Plans described below.

DRAFT SIR AND DSEIS/SDEIR

In August 1995, the Corps issued the Draft Supplemental Information Report and Draft Supplemental Environmental Impact Statement/Supplemental Draft Environmental

Impact Report. The Draft SIR evaluated 17 individual flood protection measures for Sacramento. Of those, six were included in an array of nine flood protection alternatives. Three candidate plans were carried forward for detailed analysis. In August 1995, the draft document was released for public and agency review in accordance with NEPA and CEQA. Comments were solicited and were taken into consideration when the final document was prepared. Copies of the comments received and responses to those comments are presented in appendix M.

NO-ACTION ALTERNATIVE

As part of the No-Action Alternative, it is expected that SAFCA would indefinitely extend its current agreement with Reclamation to reoperate Folsom Dam and Reservoir to achieve protection from flooding due to levee failure with a 1 in 100 chance of occurring in any one year. This would be achieved by permanently increasing the flood storage capacity from 400,000 acre-feet to a space varying from 400,000 to 670,000 acre-feet in accordance with the flood control diagram set forth in the 5-year agreement (1993 Diagram).

Under this alternative, the Federal Government would take no further action toward implementing a specific plan to increase the level of flood protection to Sacramento. The flood threat would continue, and there would be only about a 16 percent chance of passing the 200-year storm without levee failure and major flooding.

CANDIDATE PLANS

Based on the results of the Alternatives Report and subsequent analysis, three candidate plans, the Folsom Modification Plan, Stepped Release Plan, and Detention Dam Plan, were carried forward for detailed analysis along with the No-Action Alternative. The features of these plans are described below and summarized in table 1-1.

With this alternative, water supply capacity and hydropower benefits are reduced, since it includes a permanent increase in the seasonal flood storage space in Folsom Reservoir. Some environmental resources in Folsom and along the lower American River are adversely affected. However, mitigation measures implemented as a result of the agreement between SAFCA and Reclamation offset these impacts.

TABLE 1-1

Summary Comparison of Candidate Plans

Item	Alternative			
	No-Action Alternative	Folsom Modification Plan	Folsom Stepped Release Plan	Detention Dam Plan
Level of flood protection (probability of flooding)	1 in 100	1 in 180	1 in 235	<1 in 500
Probability of passing a 200-year storm (%)	16	54	68	95
Features				
Folsom Dam & Reservoir				
Flood control space	400,000/ 670,000	475,000/ 720,000	400,000/ 670,000	400,000
Maximum objective release (cfs)	115,000	115,000	145,000/ 180,000	115,000
Lower main spillway 15 feet	No	Yes	Yes	No
Outlets (No. of gates & capacity, cfs)	8 at 30,000	8 at 70,000	8 at 70,000	8 at 30,000
Modify surcharge storage	No	Yes	Yes	No
Lower American River				
Stabilize/modify levees (mi)	0	24	29	24
Raise/replace bridges (number)	0	0	3	0
Recreation trails & park areas (acres)	0	0	35	0
Environmental restoration areas (acres)	0	0	134	0
Downstream American River				
Modify Sacramento River levees (mi)	0	12	12	12
Modify Sacramento Weir & Bypass (ft)	0	0	1,000	0
Modify Yolo Bypass levees (mi)	0	0	52	0
Upstream Storage				
Detention space (ac-ft)	0	0	0	894,000
Dam height (ft)	0	0	0	508
Flood operation gates	0	0	0	20
Bridge relocations	0	0	0	2

FOLSOM MODIFICATION PLAN

This combination of measures was formulated to minimize, to the extent possible, adverse construction and operation impacts on environmental resources. The plan would provide protection from flooding due to levee failure with a 1 in 180 chance of occurring in any one year and have about a 54 percent chance of safely passing a 200-year storm. Major features of this plan include:

- Adopting a new flood control diagram for Folsom Dam and Reservoir increasing the flood storage in the reservoir to a space varying from 475,000 to 720,000 acre-feet.

- Lowering the main spillway at Folsom Dam by 15 feet and replacing the five service gates and enlarging the eight existing river outlets.

- Modifying the use of surcharge storage space in Folsom Reservoir by (1) strengthening embankments and other physical features at Folsom to accommodate the increased water-surface elevations, (2) replacing the three auxiliary spillway gates, and (3) implementing an advanced warning system and flood plain evacuation plan.

- Constructing a slurry wall in 24 miles of levees along the lower American River.

- Strengthening and raising about 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River.

With this plan, water supply capacity and hydropower benefits would be reduced, since the plan includes a further permanent increase in the seasonal flood storage space in Folsom Reservoir. Some environmental resources in Folsom and along the lower American River would be adversely affected. However, the plan includes features to offset these impacts.

FOLSOM STEPPED RELEASE PLAN

This alternative was formulated to provide a relatively high level of protection to Sacramento with limited impacts along the lower American River and downstream. It includes structural and operational modifications to Folsom Dam and Reservoir and features to increase the objective release from Folsom. It would provide protection from flooding due to levee failure with an estimated 1 in 235 chance of occurring in any year and have about a 68 percent chance of safely passing a 200-year storm. Major features of this alternative include:

- Continuing the variable flood storage space at Folsom Dam and Reservoir of 400,000 to 670,000 acre-feet.

- Lowering the main spillway at Folsom Dam by 15 feet and replacing the five service gates and enlarging eight existing river outlets.

- Modifying the use of surcharge storage space in Folsom Reservoir by (1) strengthening embankments and other physical features at Folsom to accommodate the increased water-surface elevations, (2) replacing the three auxiliary spillway gates, and (3) implementing an advanced warning system and flood plain evacuation plan.

- Constructing a slurry wall in 25.6 miles of existing levees along the lower American River.

- Increasing the objective release from Folsom Dam to 145,000 cfs and 180,000 cfs, depending on the estimated magnitude of inflows to Folsom Reservoir.

- Constructing levee, channel, and other improvements along the lower American River sufficient to convey the increased objective releases.

- Lengthening the Sacramento Weir 1,000 feet, widening the Sacramento Bypass 1,000 feet, and raising or modifying 52 miles of levees at various locations along the Yolo Bypass to accommodate the increased objective release.

- Strengthening and raising about 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River.

- Implementing environmental restoration and recreation improvement features along the lower reach of the American River Parkway.

- Mitigating to compensate for the loss of 179 acres of vegetation; 362 acres would be purchased and planted with native vegetation.

DETENTION DAM PLAN

This alternative primarily includes a detention dam and related facilities on the North Fork of the American River near Auburn. The plan would provide protection from floods due to levee failure with less than a 1 in 500 chance of occurring. It would have about a 97 percent chance of safely passing the 200-year storm. Major features of this alternative include:

- Constructing a 508-foot-high flood detention facility with a capacity for 894,000 acre-feet on the North Fork American River near Auburn.

- Constructing a slurry wall in 24 miles of levees along the lower American River.

- Strengthening and raising about 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River.

- Restoring the flood storage space of 400,000 acre-feet in Folsom Reservoir and maintaining the objective release from Folsom Dam of 115,000 cfs.

- Mitigating to compensate for the loss of approximately 1,682 acres of vegetation (including 103 elderberry shrubs) from construction and operation of this alternative (an Adaptive Management Plan would be used to manage 1,481 acres to be purchased

for mitigation along the North and Middle Forks; an additional 2,962 acres on the Yuba River near Englebright Lake would be purchased and planted with native vegetation).

Of all alternatives considered, this alternative would provide the highest level of flood protection to the Sacramento area. It would have a minor beneficial effect on water supplies and hydropower generation of the CVP (Central Valley Project) by restoring the authorized 400,000 acre-foot flood storage space in Folsom Reservoir. It includes features to offset potential adverse impacts on environmental resources in the detention dam area, primarily due to infrequent inundation.

DESCRIPTION OF PROJECT AREA

The alternatives described above would produce impacts in the following areas:

- Upper American River. The area encompassing the American River basin upstream from Folsom Reservoir, including (1) the Auburn Dam site, (2) the 42,000 acres of land around the damsite which encompass the Auburn State Recreation Area and lie within Reclamation's authorized Auburn Dam project limits, (3) communities in Placer and El Dorado Counties surrounding the Auburn State Recreation Area, and (4) the three largest non-Federal reservoirs in the watershed—Union Valley, Hell Hole, and French Meadows (plate 1 of the SIR).

- Natomas. The area encompassing the east levee of the Sacramento River from the mouth of the Natomas Cross Canal to the mouth of the American River, a portion of the north levee of the American River, the Natomas East Main Drainage Canal and Pleasant Grove Creek Canal, and the Natomas Cross Canal.

- Folsom Reservoir Area. The area encompassing Folsom Dam and Reservoir and including the stilling basin downstream from the dam; the residential development surrounding the dam and reservoir; and the footprint of the reservoir, which would be subject to periodic changes in surface elevation (plate 1).

- Lower American River. The area encompassing (1) the American River Parkway and (2) the flood plain of the lower American River from Folsom Dam downstream to the confluence with the Sacramento River (plate 1).

- Upper Sacramento River. The area encompassing (1) Shasta and Keswick Reservoirs, (2) the upper reach of the Sacramento River from the Fremont Weir to Keswick Reservoir, (3) Clair Engle Reservoir and the Trinity River, and (4) Oroville Dam and

Reservoir and the Feather River from Thermolito Afterbay to the confluence with the Sacramento River and South Fork Yuba River (figure 1-1).

- Downstream from American River. The area encompassing (1) the Sacramento River downstream from the mouth of the Natomas Cross Canal, (2) the Yolo Bypass and the lands immediately adjacent to the bypass, (3) the Sacramento Weir and Bypass and adjacent lands, and (4) the Sacramento-San Joaquin Delta, the roughly triangular area bounded by the City of Sacramento on the north, Pittsburg on the west, Tracy to the south, and Stockton to the east (figure 1-2).

- Yuba River Area. The area encompassing the Yuba River upstream from Englebright Dam. The area would be used to provide mitigation for impacts to vegetation affected by construction of the Detention Dam Plan.

ENVIRONMENTAL IMPACTS AND MITIGATION

Tables 1-2 through 1-4 identify the significant adverse impacts and mitigation requirements likely to result from implementing the Folsom Modification Plan, the Stepped Release Plan, and the Detention Dam Plan. Table 1-5 identifies potential impacts of and mitigation for Federalizing permanent reoperation.

AREAS OF CONTROVERSY

The following significant areas of controversy were identified during this study:

Folsom Modification Plan

- Increasing the seasonal flood space in Folsom Reservoir and concern about impacts on water and power supply, local water availability, water quality, and recreation.

- Relatively low level of flood protection achieved and likely preclusion of other options capable of providing higher levels of protection and other water resource goals.

- The plan does not effectively address coping with residual risk from flooding.

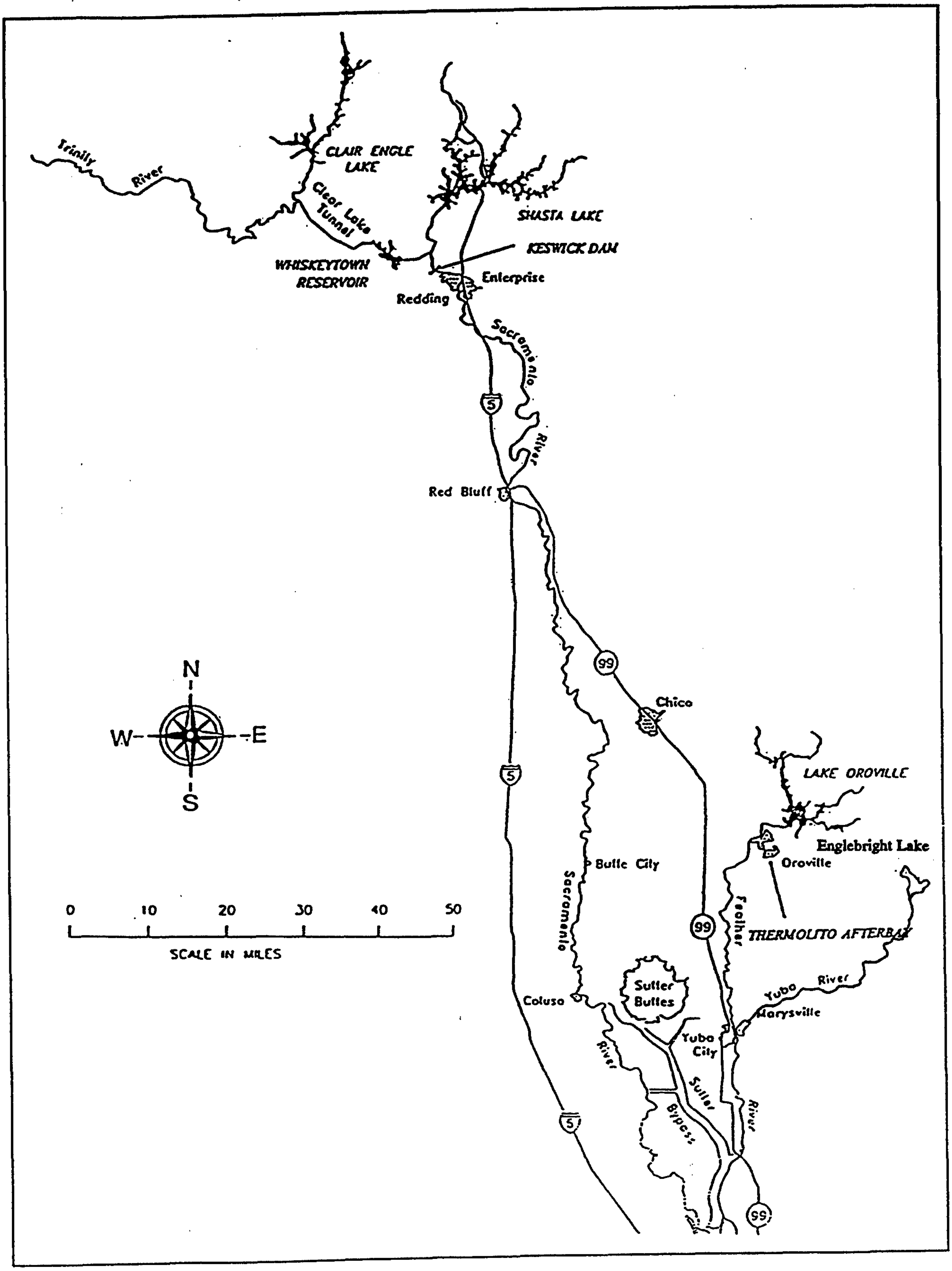


Figure 1-1. Upper Sacramento River Area.

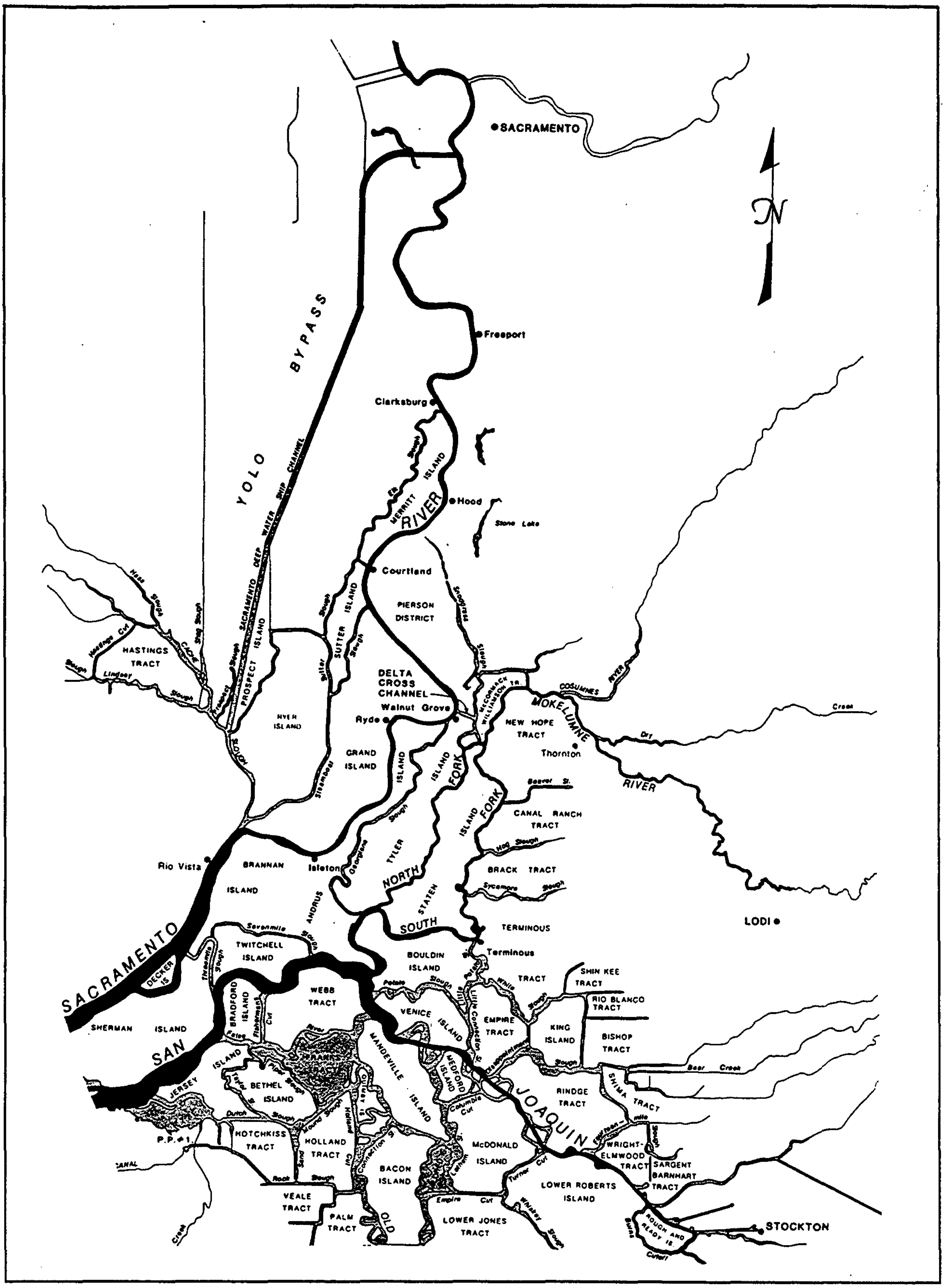


Figure 1-2. Downstream from the American River.

TABLE 1-2

Summary of Significant Impacts and Mitigation
Folsom Modification Plan

Resource	Impact	Mitigation
Fisheries	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Endangered species	Possible impacts to Swainson's hawk nesting habitat.	Require adherence to DFG guidelines.
Cultural resources	Construction activities would affect culturally sensitive areas in Folsom Reservoir.	Determine eligibility of site for inclusion in National Register and identify additional sensitive areas for study.
Water quality	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Recreation	Levee modification work along lower American River would disrupt use of bike trail. Lower water-surface elevations would reduce availability of boat launching facilities at Folsom Reservoir.	Route trail around construction areas using detours to surface streets. Extend low-water boat ramps as required.
Traffic and transportation	Levee raising and modification work along the west levee of Natomas would have temporary impacts during construction.	Reroute Garden Highway traffic to avoid construction areas.
Air quality	Construction equipment and activities would result in emissions and dust.	Require equipment to be operated in accordance with contract specifications. Design and implement a dust suppression program.
Noise	Construction work at Folsom Dam and levee modification work along the lower American River and downstream would cause temporary noise impacts.	Require equipment to be operated in accordance with contract specifications.

TABLE 1-3

Summary of Significant Impacts and Mitigation
Stepped Release Plan

Resource	Impact	Mitigation
Fisheries	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Vegetation and wildlife	Loss of 37 acres of riparian and upland habitats along lower American River.	Create 113 acres of replacement habitat at borrow areas along lower American River.
	Loss of 120 acres of wetland, riparian, and upland habitats in Sacramento and Yolo Bypasses.	Create 116 acres of replacement habitat at Liberty Island.
Endangered species	Loss of 137 elderberry shrubs due to levee modification.	Replace shrubs lost at a 3:1 ratio in mitigation areas.
	Possible effect on Swainson's hawk nesting habitat.	Require adherence to DFG guidelines.
	Possible effect on giant garter snake resulting from construction.	Require adherence to DFG guidelines.
Cultural resources	Construction activities would affect culturally sensitive areas along lower American River.	Determine eligibility of site for inclusion in National Register and identify additional sensitive areas for study.
Water quality	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work during dry season.
Visual resources	Levee construction work along lower American River would have permanent impacts.	Unmitigable, unavoidable impact.
Recreation	Levee modification work along lower American River would disrupt use of bike trail.	Route trail around construction areas using detours to surface streets.
	Creation of new bike trail, Gateway and 7th Street parks.	Would benefit recreational resources.
Traffic and transportation	Levee raising and modification work along the west levee of Natomas would have temporary impacts during construction.	Reroute Garden Highway traffic to avoid construction areas.
Air quality	Construction equipment and activities would result in emissions and dust.	Require equipment to be operated in accordance with contract specifications.
		Design and implement a dust suppression program.
Hazardous and toxic waste	A dump site is located in the area where the Sacramento Bypass levee would be moved 1,000 feet to the north. There are no other HTRW sites known in the construction area.	Excavate the contents of this site and move to the landfill north of Davis.
Noise	Construction work at Folsom Dam and levee modification work along the lower American River and downstream would cause temporary noise impacts.	Require equipment to be operated in accordance with contract specifications.

TABLE 1-4

Summary of Significant Impacts and Mitigation
Detention Dam Plan

Resource	Impact	Mitigation
Fisheries	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches.
Vegetation and wildlife	Construction of dam and relocation of Highway 49 would eliminate 313 acres of riparian and upland habitats. Operation of detention dam would eliminate 1,369 acres of riparian and upland habitats.	Implement adaptive management plan. Plant 4,443 acres of replacement habitat at inundation area (1,481 acres) and Yuba River area (2,962 acres).
Endangered species	Loss of approximately 103 elderberry shrubs from periodic inundation of 210 shrubs (73 with exit holes). Possible impacts to Swainson's hawk nesting habitat. Possible effect on giant garter snake resulting from construction.	Plant total of 7,008 seedlings at various areas along Middle Fork American River. Require adherence to DFG guidelines. Require adherence to DFG guidelines.
Cultural resources	Construction and operation would affect 180 known historic and prehistoric sites in the American River canyon.	Determine eligibility of sites for inclusion in National Register and identify additional sensitive areas for study. Complete inventory and investigation process and determination of eligibility.
Water quality	Eroded materials from construction areas may enter river during storm season.	Install sediment curtains, perimeter berms, and interceptor ditches. Work adjacent to river during dry season.
Air quality	Construction equipment and activities would result in emissions and dust.	Require equipment to be operated in accordance with contract specifications. Design and implement a dust suppression program.
Recreation	Levee modification work along lower American River would disrupt use of bike trail. Operation of detention dam would flood facilities at Lake Clementine. Recreation trails and access areas in detention area may be damaged during inundation.	Route trail around construction areas using detours to surface streets. Flood proof or remove facilities before storms. Offset damage to the trail system through vegetation management under the Adaptive Management Plan, which includes some repair of trails following floods.
Visual resources	Aggregate extraction, transport, and concrete-mixing activities would alter the viewshed. Construction of the dam would create a 508-foot-high structure in the canyon, and relocation of Highway 49 would create new, permanent obstructions to the viewshed.	Remove the extraction and mixing equipment and restore the area using native vegetation. Unmitigable, unavoidable impact.
Traffic and transportation	Levee modification work along the west levee of Natomas would have temporary impacts during construction. Probable effects from Highway 49 construction.	Reroute Garden Highway traffic to avoid construction areas. Develop mitigation plan.

TABLE 1-5

Summary of Potential Impacts and Mitigation of Federal Participation in Permanent Reoperation

Resource	Potential Impacts	Potential Mitigation
Water supply	Reduced CVP deliveries.	Purchase water from outside watershed.
	Increased pumping costs to local water suppliers taking water from Folsom Lake.	Purchase replacement power.
Hydropower	Reduced hydropower generation.	Purchase replacement power.
Recreation	Reduced recreational use when Folsom Lake is lowered.	Incorporate SAFCA's proposed mitigation (extend boat ramps).
Fisheries	Reduction in lower American River flows or increased temperatures may affect fish reproduction.	Maintain flows no less than reoperation so that impacts are not significant.
	Possible temperature effects to fish hatchery.	Incorporate SAFCA's proposed mitigation (temperature shutters).
	Reduction in Folsom Lake fish production and survival.	Impacts not significant.
	Reduction in fish production and survival in the Sacramento River or Delta waterways.	Impacts not significant.
Vegetation and wildlife	Losses of vegetation or wildlife populations.	Impacts not significant.
Water quality	Adverse changes to water quality.	Impacts not significant.
Cultural resources	Lower Folsom Lake levels occasionally expose historically significant resources to looting.	Identify and record sites as required by the National Historic Preservation Act.
		Establish vehicle barriers and ranger patrols to protect site.
Visual resources	Temporary reductions in scenic quality of various lakes.	Impacts not significant.
Land Use and Population	Increased flood protection may increase flood plain development.	Provide mitigation by local land use planning process as necessary.

Stepped Release Plan

- Hydraulic impacts to area downstream from American River due to higher objective releases.
- Continual reoperation of Folsom Dam and Reservoir and related impacts primarily on water supply, water quality, and recreation.

- Concern about higher objective releases along lower American River and the relationship of the releases to the potential for the levees to be modified to adequately accommodate the flows.

Detention Dam Plan

- Relationship between the Detention Dam Plan and the authorized multipurpose Auburn Dam.

- The extent of environmental and recreational impacts which would result from temporary inundation during large storms and the appropriate scope of mitigation for these impacts.

- Potential impacts from sloughing in the North and Middle Forks of the American River during periods when the detention dam would detain water.

- Potential impacts from reservoir-induced seismicity during periods when the detention dam is detaining water.

General

- The relationship between the Federal Principles and Guidelines for water resource projects adopted by Congress in 1986 and Section 404(b)(1) of the Clean Water Act, including the application of 404(b)(1) guidelines to the analysis of project alternatives and the requirements and effects of compliance with Section 404(r).

UNRESOLVED ISSUES

The following issues remain unresolved:

- The difference of opinion between the Corps and FWS on appropriate strategies to mitigate project impacts in the upper American River canyon resulting from periodic inundations.

- The Corps submitted a formal consultation request for the Detention Dam Plan under Section 7 of the Endangered Species Act on October 31, 1995. Accompanying the formal request was a Biological Assessment describing the anticipated adverse effects of this plan on the threatened VELB and mitigation proposed to compensate for the effects. Conclusion of consultation is anticipated 90 days after the October 31, 1995 date. At the end of the 90-day period, the U.S. Fish and Wildlife Service has an additional 45 days to finalize and deliver its biological opinion. The anticipated

effects and mitigation proposed are discussed in chapter 9. Appendix K includes a final Biological Data Report. As described in chapter 11, conclusion of consultation will result in the FWS providing a Final Supplemental Fish and Wildlife Coordination Act Report that documents project effects to nonendangered species.

SELECTED PLAN

PLAN SELECTION

Chapter VI of the Main Report presents an evaluation for each plan. The Detention Dam Plan rated highest overall based on criteria discussed in the Main Report. Both The Reclamation Board and SAFCA identified this plan as the locally preferred plan. On the basis of these recommendations, this alternative was identified as the selected plan for submittal to Congress.

DETENTION DAM PLAN

Environmental commitments for the selected plan are:

- The compensation objective for this mitigation project is the replacement of acreage of vegetative cover types projected to be lost as a result of construction and operation of the proposed flood detention dam. As mitigation for the losses, 1,481 acres of land along the North and Middle Forks would be purchased and managed using the adaptive management plan, and 2,692 acres along the Yuba River would be purchased and planted with 200 plants per acre.

- Seven thousand eight seedlings would be replanted in-kind and onsite (a 3:1 replacement ratio) in suitable areas along the Middle Fork American River. Because survey results show that most shrubs are found mostly on the middle fork, replanting would be done there to assure the greatest chance of survival.

- Periodic, temporary inundation of the canyon area could cause substantial site disturbance to the 180 cultural resource sites. Impacts from temporary inundation, wave action, and a new zone of wet-dry cycling could be reduced by data recovery, documentation, and structural protection, but not to a less-than-significant level.

- Relocating Highway 49 and constructing a flood detention dam near Auburn would cause the replaced Highway 49 to be flooded periodically along its present alignment where it crosses the North Fork of the American River. The existing Highway 49

corridor would be maintained as a recreation access corridor to the confluence of the North and Middle Forks by Placer or El Dorado County or by SAFCA.

- A dust suppression plan would be prepared and implemented for the construction areas. Both a determination of conformity and transportation conformity would be prepared. Coordination with the appropriate agencies in Placer, El Dorado, and Sacramento Counties would be completed.

- The construction equipment would be equipped with appropriate mufflers, and stationary sources would be shielded to avoid or reduce the increase in ambient noise levels. The increase in noise levels from construction and quarrying would result in significant and unavoidable effects that may not be mitigated to a less-than-significant level. This impact is temporary and would only last for the duration of the construction.

- Visual resources around the dam would be restored using native vegetation to repair construction access roadways and work areas which are not needed for operation. Mitigation for effects to visual resources resulting from construction of the dam and bridge is not feasible.

CUMULATIVE IMPACT SUMMARY

The American River Watershed Project report examines three action alternative flood control plans and a No-action Alternative that represents the most likely "default" course of action in the event that the "No-Action" Alternative is authorized. Other projects with the potential for creating cumulative impacts in conjunction with the American River Watershed Project are discussed in relation to each major action alternative in chapter 10. For this summary, only the cumulative impacts of the No-Action Alternative and the three action plans are summarized and shown below:

- **No-Action alternative**. With no action, cumulative impacts would occur if it is assumed that Folsom Reservoir becomes permanently reoperated according to the 1993 flood control diagram. These impacts include minor regional changes due to decreases of stored water and production of hydropower at Folsom, that are linked to larger projects such as the CVP/SWP (Central Valley Project and State Water Project). In addition, there would be relatively greater cumulative impacts to local resources such as water supply and water-oriented recreation at Folsom Lake. In the lower American River the fisheries, riparian vegetation, and wildlife; water quality; and cultural and visual resources would be affected somewhat by of permanent reoperation. However, average annual impacts are projected to be minor; over the

longterm, they will be within a few percent of existing production levels. As discussed in chapter 10, when compared to the systemwide demands for CVP/SWP water, the impacts of permanent reoperation are considered to be very small.

- Folsom Modification Plan. Potential cumulative adverse impacts of the this plan are greater than the No-Action Alternative because the plan includes constructing improvements to Folsom Dam, the lower American River levees, and the east levee of the Sacramento River. In addition, there would be an increase in the amount of flood space reservation in Folsom Reservoir. As with the No-Action Alternative, local resources produced at Folsom Lake that would probably be significantly affected by reoperation include water supply, hydropower, cultural resources, and recreation. Cumulative impacts to these resources may be considerable in some years, but probably would not be of sufficient magnitude to be called significant overall because alternative recreation areas and water and power supplies are available at other lakes that are either privately owned or part of the CVP and SWP systems. Therefore, the Folsom Modification Plan would not significantly increase the cumulative effects on the CVP and SWP operations.

- Stepped Release Plan. Potential cumulative adverse impacts of constructing facilities necessary for this plan are locally and regionally even more significant than for the Folsom Modification Plan due to more construction and a higher floodway design. However, detailed projections of impacts to fish and wildlife habitat and recreation show that mitigation measures would offset potential losses. (See Chapter 8.) Therefore, there should be no cumulative adverse impacts to these resources associated with long-term operation of the Stepped Release Plan. Proposed Folsom Lake reoperation would be the same as discussed for the No-Action Alternative. Construction of levee modifications to handle greater floodflows should result in no increased loss of wildlife or fisheries, recreation facilities, or utilities compared to the No-Action alternative. Construction of new recreation facilities along the lower American River would result in beneficial cumulative impacts. On average, as with the No-Action Alternative, cumulative losses of recreation, water, and power production at Folsom Lake can be compensated by integrating reoperations with existing regional production.

- Detention Dam Plan. The potential cumulative adverse impacts of this plan include vegetation loss from periodic inundation within the upper American River. Vegetation mortality, soil losses, and physical damage to roads, trails, and other recreational facilities cumulatively over time would contribute to loss of wildlife and fisheries habitat values; recreational capabilities; and visual quality for existing uses such as whitewater rafting, hiking, and nature appreciation. However, the temporary conditions of inundation are projected to greatly lessen impacts to these resources because the inundation should not exceed 28 days for major storms, and the

inundation would occur during the winter dormancy when plants are least likely to be affected. Regionally, because the proposed dam would be operated for temporary flood detention rather than permanent water impoundment, cumulative impacts, though significant, would be offset by mitigation that compensates for lost vegetation. Cumulative impacts to recreation are thought to be minimal because the area would be inundated during the off season for most recreation.

INTENDED USES OF THE SEIS/EIR

This SEIS/EIR is intended to serve as a stand-alone document. It will be used to inform the following administrative and legislative bodies whose approval is needed to select and fund a plan of flood protection improvements along the American River: the United States Congress; the Corps of Engineers; The Reclamation Board, State of California; and the Board of Directors of SAFCA. The SAFCA Board will specifically rely on this document to create a local financing district to raise the local share of the cost of the approved project.

CHAPTER 2

PURPOSE OF AND NEED FOR ACTION

BACKGROUND

The three forks of the upper American River originate high in the Sierra Nevada and drain approximately 1,875 square miles of mountainous terrain before converging at Folsom Dam and Reservoir, about 25 miles northeast of downtown Sacramento (plate 1). Completed in 1956 by the Corps of Engineers, Folsom was originally authorized in the Federal Flood Control Act of 1944 as a single-purpose flood control facility, designed to protect the urbanized flood plain in Sacramento. In 1949, prior to commencement of construction, the 1944 authorization was amended to enlarge the reservoir, add water supply and hydropower to its purposes, and integrate Folsom into the multipurpose CVP (Central Valley Project) operated by Reclamation. During the flood season, Reclamation is required to operate Folsom in accordance with flood control criteria set forth in a flood control diagram adopted by the Secretary of the Army under the authority of Section 7 of the Flood Control Act of 1944. Over the years this diagram has been modified to reflect operating experience. The current diagram became effective November 7, 1986.

In the 1950's, Corps designers envisioned a reservoir with a flood storage capacity adequate to contain the flood of 1937, then the flood of record in the American River watershed, without releasing flows in excess of 115,000 cfs (cubic feet per second) into the leveed channel downstream from Folsom Dam. At that time, the maximum flood event which could be contained under this design standard (Reservoir Design Flood) was thought to be extremely rare. However, in December 1955, just months before the newly constructed reservoir was scheduled to formally commence operations, a major storm blanketed northern California. Heavy rains caused uncontrolled flooding in the Feather River basin north of Sacramento, triggering catastrophic property damage and loss of life in the Yuba City/Marysville area. In the American River basin, the storm generated enough runoff to fill the empty reservoir behind Folsom Dam in just 4 days, a feat the designers had thought would take several months. Shortly thereafter, the Corps reevaluated the hydrologic assumptions underlying earlier estimates of the protective capacity of Folsom and concluded that the Reservoir Design Flood was probably no more than a 1/120-year event. Folsom was thus deemed incapable of providing Sacramento with the level of flood protection intended in the 1949 authorization. During the decades that followed, a concerted effort was originally made to augment Folsom Reservoir by creating new storage capacity at the confluence of the North and Middle Forks of the American River near Auburn for water, power, recreation, and flood control.

The multipurpose Auburn Dam was authorized in 1965. Construction by Reclamation began shortly thereafter, and by 1975 a cofferdam, diversion tunnel, and excavated keyways were in place. However, growing environmental opposition, changing Federal water resource development priorities, and a significant earthquake near Oroville Dam resulted in a halt in construction to review the seismic safety of the dam. Although a panel of dam engineering experts determined that a multipurpose facility could be safely constructed at the site, financial support for the dam waned and construction did not recommence.

Sacramento joined the National Flood Insurance Program in 1978 and adopted appropriate ordinances to ensure that its land use planning policies complied with NFIP standards. Since these standards focused on development in areas subject to flooding in a 100-year flood event, and since Sacramento was then deemed to have at least a 120-year level of protection, development proceeded without restriction in low-lying areas within the American and Sacramento River flood plain. This flood plain encompasses a land mass of more than 100,000 acres (plate 6). About half this land lies within Natomas, an area which now contains over $2 billion worth of damageable residential, commercial, and industrial property, including Sacramento Metropolitan Airport. Outside Natomas and the Dry Creek area immediately east of the basin, the flood plain straddles the American River. To the north, it covers about 6,000 acres. South of the American River, the flood plain covers about 45,000 acres and encompasses much of downtown Sacramento, the State Capitol, California State University at Sacramento, the City of Sacramento's water treatment facility, and a number of large residential areas to the south. Altogether, the Corps estimates that the flood plain area outside Natomas and Dry Creek contains nearly 400,000 residents and about $35 billion worth of damageable property. Direct structure-inundation damages from levee failure during a 400-year storm would be about $16 billion. Grade elevations in most of these areas are significantly lower than water-surface elevations in the river channels during major floods, thereby creating the potential for extensive deep flooding if levees are overtopped or if they otherwise fail due to prolonged high flows. As a result, the Corps estimates that a levee failure along the American River during a 100-year storm could cause as much as $9 billion in damages.

PURPOSE

The purpose of this SEIS/EIR is to analyze the environmental and related impacts of the various plans which could be implemented and that would significantly increase the level of protection for much of the Sacramento area from flooding from the American River. The SEIS/EIR was prepared in response to direction provided by Congress in the Fiscal Year 1993 Supplemental Appropriations Act to supplement information presented in the December 1991 American River Watershed Investigation, California, Feasibility Report.

This report:

- Reviews significant assumptions, alternatives, conclusions, and recommendations made in the 1991 feasibility report.
- Discusses significant changes to baseline conditions which influence the formulation of acceptable and effective alternative flood control plans and which have occurred since completion of the feasibility report.
- Describes additional studies and their results in compliance with guidance provided in, and as the result of, the 1993 Department of Defense Appropriations Act.
- Reassesses and revises alternative plans to increase flood protection to Sacramento in light of the additional studies.
- Displays the three candidate plans.
- Presents the NED plan, which is also the non-Federal sponsor's selected plan.

NEED FOR ACTION

The community's exposure to uncontrolled flooding was powerfully demonstrated in February 1986, when major storms in northern California caused record floodflows in the Sacramento River Flood Control System. Although the Sacramento metropolitan area was largely spared, localized flooding was serious to the north in the town of Rio Linda and in the Pleasant Grove area of South Sutter County. In addition, floodwaters forced hundreds of residents in the Rio Linda/Elverta and Strawberry Manor areas of Sacramento County to flee their homes. Only a determined flood fight prevented a collapse of the east levee of the Sacramento River (which protects more than 35,000 residents of the Natomas area), 5 miles north of downtown Sacramento. In the American River basin, releases from Folsom Dam exceeded the design capacity of the lower American River levee system for over 2 days and caused extensive erosion along the toe of the north and south levees of the American River near California State University, Sacramento. Had the rains continued, even higher releases from Folsom Dam would have been required, with the potential for levee failure.

In March 1991, the Corps' Sacramento District published a draft feasibility report and draft EIS/EIR which identified as the NED Plan the 400-year alternative, an expandable flood detention dam at Auburn capable of storing up to 894,000 acre-feet of floodwater. In June 1991, The Reclamation Board and SAFCA jointly requested the Corps to pursue the 200-year alternative, a scaled-down version of the NED Plan, consisting of an expandable flood detention dam at Auburn capable of temporarily storing up to 545,000 acre-feet of floodwater.

Based on these considerations, the Assistant Secretary of the Army granted an exception to the NED Plan, and the 200-year alternative was identified as the "Selected Plan" in the final feasibility report and final EIS/EIR issued in December 1991 for administrative review in Washington and eventual presentation to Congress. For a variety of procedural and substantive reasons, Congress declined to authorize the selected plan in 1992.

Congress asked that additional information be provided on several alternatives to the plan selected in the 1991 feasibility report, including higher flood control releases from Folsom Dam, use of existing upstream reservoirs, and operational and structural modifications to Folsom Dam and Reservoir. This document was prepared in response to direction provided by Congress in the Fiscal Year 1993 Supplemental Appropriations Act to supplement information presented in the December 1991 ARWI (American River Watershed Investigation, California) Feasibility Report. This Supplemental Information Report also addresses a number of changed conditions and new alternatives that have been developed since the completion of the feasibility report.

EFFORTS TO PROVIDE INCREASED FLOOD PROTECTION

AMERICAN RIVER WATERSHED INVESTIGATION (ARWI)

On the basis of the Corps findings and conclusions, the Continuing Appropriations Act (Public Law 100-202, July 1988) authorized the Corps to commence the feasibility phase of the ARWI (American River Watershed Investigation) on a cost-shared basis with the State. The State in turn entered into an arrangement with local agencies interested in the project to act as local sponsors. These agencies included Placer County, which contributed funds to the feasibility study in its initial phases, and the agencies which now comprise and are represented by SAFCA: City of Sacramento, Sacramento County, Sutter County, Reclamation District 1000, and the American River Flood Control District.

The plan formulation process consisted of the following tasks:

- Establish specific objectives for implementing a plan to resolve the identified flood problems and, to the extent possible, related water resource needs.
- Define constraints and criteria for formulating an implementable plan.
- Identify, document, and evaluate management measures to address the planning objectives.
- From the most viable management measures, assemble, display, and evaluate an array of alternatives, consistent with planning constraints and criteria, to address the study objectives.

- Identify the plan that maximizes NED (national economic development) benefits.

- Compare and evaluate the alternatives and select and display a plan for recommended implementation.

In carrying out these tasks, the Corps considered a wide range of potential flood control measures. With respect to controlling American River flows, the following measures were found to be feasible:

- Construct a flood detention dam near Auburn.

- Increase the amount of storage allocated to flood control on a seasonal basis at Folsom.

- Lower the spillway at Folsom to permit more efficient use of the space allocated to flood control.

- Increase the design release from Folsom into the lower American River channel.

These measures were combined into six alternatives, including a 400-year detention dam at Auburn, a 200-year detention dam, a 150-year plan containing structural and operational modifications at Folsom with downstream levee improvements, and three 100-year (FEMA) alternatives involving increased Folsom storage (only), downstream levee improvements (only), and a scaled-down version of the 150-year plan. These alternatives were carried forward for detailed evaluation within the framework of the principles and guidelines adopted by Congress in 1986 to guide the planning of Federal water resource projects.

Three overriding considerations were offered in support of this alternative: (1) the smaller dam met the non-Federal sponsors' minimum goal of providing Sacramento with at least a 200-year level of flood protection; (2) the 200-year alternative was less costly than the NED Plan; and (3) the smaller dam was thought to be more acceptable to environmental interests than the NED Plan. Instead, in language set forth in Section 9159 of the Department of Defense Appropriations Act for Fiscal Year 1993 (Public Law 102-396) and subsequent congressional correspondence (see chapter I), the Corps was directed to reevaluate Sacramento's flood control options and provide the following: (1) additional information on the gating and expandability features of the flood detention dam, (2) a more detailed analysis of the costs and benefits of modifying Folsom Dam, improving the efficiency of flood control operations at Folsom, and increasing the conveyance capacity of the American River levee system, and (3) a reassessment of the costs and benefits of enlarging Folsom Reservoir or, alternatively, creating offstream storage capacity along Deer Creek in the Cosumnes River watershed.

SIGNIFICANT ACTIONS SINCE 1992

The following actions subsequent to the 1992 legislative session have affected the scope and nature of the Corps response to Congress' call for a reevaluation of the American River project: (1) SAFCA's construction of the Natomas features of the project with local funds (SAFCA Local Project); (2) execution of a 5-year agreement between SAFCA and Reclamation to modify the operation of Folsom Reservoir (Interim Reoperation); (3) initiation of a bank protection project affecting up to 13,800 lineal feet along critical reaches of the lower American River under the authority of the Sacramento River Bank Protection Project (Lower American River Bank Protection Project); and (4) initiation of a regional water study, the American River Water Resources Investigation by Reclamation in conjunction with Sacramento, Placer, El Dorado, and San Joaquin Counties. These actions and their effect on the Corps plan formulation process are discussed below.

SAFCA Local Project

This project, which modifies the project authorized by Congress, received a Department of the Army permit in June 1993 and will provide the Natomas basin and portions of the lower Dry and Arcade Creek watersheds with 100-year or greater flood protection. The project is designed to accommodate flows in the lower American River up to 180,000 cfs and is thus compatible with all the main stem American River alternatives being evaluated in connection with the ARWI. Nevertheless, the project does not depend on any upstream improvements to remove the protected areas, including the Natomas basin, from the regulatory flood plain. These project improvements and the direct and indirect (growth-inducing) impacts caused by the project are fully described in the Final Environmental Impact Report for the Revised Natomas Area Flood Control Improvement Project (Final EIR) and the supplemental environmental documents issued in connection with the Final EIR which are available through the SAFCA office at 926 J Street, Suite 424, Sacramento, California 95814. (See plate 8.)

Interim Reoperation

This project was implemented by agreement between SAFCA and Reclamation in February 1995. The implementing agreement requires Reclamation to operate Folsom Reservoir during the flood season in accordance with a flood control diagram (1993 Diagram) designed to reduce the probability of flooding by levee failure to a 1 in 100 chance in any year. The 1993 Diagram ties Folsom Reservoir storage to storage in the three largest non-Federal reservoirs in the American River watershed: Union Valley, Hell Hole, and French Meadows. When these reservoirs have between them at least 200,000 acre-feet of space available for flood storage, Folsom may store up to 575,000 acre-feet of water, reserving at least 400,000 acre-feet of empty space for flood storage as required under the Corps 1986 flood control diagram. When the upstream reservoirs fill so that less than 200,000 acre-feet of space is left for flood storage, Folsom Reservoir must be drawn down to compensate. When the upstream reservoirs are full and no

space is available for flood storage, Folsom may store no more than 305,000 acre-feet of water, reserving 670,000 acre-feet for flood storage. To protect the environmental and recreational resources in the lower American River, the Interim Reoperation implementing agreement further obligates Reclamation to ensure that Folsom Reservoir releases during the spring refill period from March 1 to June 30 are at least equal to the lesser of (1) the releases that would have been made if Folsom had continued to be operated in accordance with the 1986 Diagram or (2) 3,000 cfs.

The implementing agreement obligates SAFCA to mitigate the potential adverse impacts of this changed operation. These impacts include reduced CVP water deliveries, reduced CVP power generation, increased power costs for local water agencies taking deliveries directly from Folsom Reservoir, reduced reservoir recreation opportunities, increased exposure of shoreline cultural resources to damage, and increased temperatures potentially harmful to the fishery in the lower American River. The agreement anticipates that this mitigation will generally take the form of annual payments for replacement of the lost or expended resources. However, SAFCA has undertaken two significant permanent improvements in connection with Interim Reoperation: (1) modification of the shutter system which controls the elevation (and therefore the temperature) of releases through the main dam and (2) boat ramp extensions in the Brown's Ravine/Hobie Cove area to permit access to the reservoir at the lowest water-surface elevations required under the 1993 Diagram.

Sacramento River Bank Protection Project, Lower American River

The Corps of Engineers and The Reclamation Board in cooperation with the Sacramento Area Flood Control Agency are proposing to construct streambank protection on the lower American River under the Federally authorized Sacramento River Bank Protection Project. The purpose of the streambank protection is to protect the integrity and reliability of Federal flood control levees, while preserving existing environmental values and the wild and scenic recreational status of the lower American River and parkway.

Bank protection is proposed under the currently authorized Sacramento River Bank Protection Project because (1) immediate actions are necessary at sites to reduce the threat of levee failure, (2) an existing authorized project can address these critical sites, and (3) bank protection is needed on the lower American River regardless of what alternative is selected as a result of the American River Watershed Investigation.

Since January 1994, the Lower American River Task Force, composed of flood control agencies, resource protection agencies, and local interest groups, has been developing a locally-preferred erosion control plan for the lower American River which includes streambank protection measures to reduce the immediate and future risks of levee failure. The plan for managing bank erosion developed by consensus among the Task Force participants comprises immediately needed streambank protection at four critical sites comprising 9,100 linear feet of streambank and bank protection needed for the longer term. The immediate bank protection is proposed for construction in 1997. Longer term

streambank protection may be needed at any location along the Federal levee system where levees become threatened by erosion. Potential sites have been identified (13 sites comprising 9,000 linear feet) that may become critical in the future. Other sites may be identified from future flood events.

The designs for streambank protection developed by the Task Force are intended to preserve and recreate as much aquatic and riparian habitat values and visual quality as feasible. Designs contain well-vegetated, visually irregular surfaces composed of rock, soil, and biotechnical materials. Large, woody material is proposed along the shoreline, and marsh and riparian vegetation would be established on the streambank protection structure.

A Supplemental Draft Environmental Impact Statement/Environmental Impact Report is scheduled to be distributed for public review and comment in the spring of 1996. This environmental document will assess the environmental effects of the Task Force's locally preferred streambank protection project and alternative plans.

American River Water Resources Investigation

The American River Water Resources Investigation was initiated in the fall of 1991 under the authority of the American River Basin Development Act (Public Law 81-356). It is being organized by the Bureau of Reclamation. Federal funding is available on a year-to-year basis through the House Appropriations Committee, provided 50 percent matching funds are contributed in equal shares by the non-Federal sponsors of the study—the Sacramento Metropolitan Water Authority, the American River Authority, the San Joaquin Flood Control and Water Conservation District, and the Sacramento County Water Agency (in partnership with the City of Sacramento). The purpose of the investigation is to identify significant water resource needs within the American River study area, formulate alternative plans to meet those needs, and determine a preferred alternative. The study objectives are to: (1) manage ground-water basins and surface-water supplies to maintain beneficial uses and to protect water quality; (2) provide water to meet projected (year 2030) water demands, including municipal, industrial, and agricultural needs; (3) provide flows sufficient for water-oriented recreation; (4) sustain riverine and associated biological environment; and (5) be consistent with ongoing activities addressing flood protection needs. The study is proceeding in four phases. Phase one consists of identifying water-related needs by examining existing systems. This phase was completed in February 1995. Phase two consists of plan formulation, analysis, evaluation, and identification of a preferred plan. Reclamation completed this phase in July 1995. Phase three, in which Reclamation will determine the feasibility of the preferred plan, prepare a Planning Report and Draft Environmental Impact Report/Draft Environmental Impact Statement, and circulate this document for public review and comment, is due for completion in 1996. In Phase four, public comments will be addressed, and a final report will be prepared and then submitted for a decision by Congress in 1996.

ALTERNATIVES REPORT

In November 1994, the Corps took the first step in the ARWP reevaluation by issuing an Alternatives Report designed to address the issues raised by Congress in Public Law 102-396, account for changes in the assumptions and methodology used in the 1991 final report, and provide the non-Federal sponsors with an opportunity to reassess their recommendations with respect to the project.

Essential Conclusions

In answer to the issues raised in Public Law 102-396, the Alternatives Report reaffirmed the following essential conclusions of the 1991 final report. First, with the completion of the remedial work needed to stabilize the east levee of the Sacramento River, uncontrolled flooding along the American River poses the primary threat to Sacramento. Second, although structural and operational modifications to Folsom Dam and Reservoir combined with an increase in the conveyance capacity of the lower American River levee system would significantly reduce the risk of such uncontrolled flooding, construction of substantial new flood storage capacity at Auburn would be the most cost-effective approach to protecting the people and property occupying the American River flood plain. Third, creating new storage through enlarging Folsom Reservoir or through constructing an offstream reservoir along Deer Creek in the Cosumnes River watershed would not be cost effective and would give rise to a series of additional problems that would make these alternatives unacceptable. Fourth, a flood detention dam could be designed and constructed at the Auburn site in a manner that would not preclude efficient expansion of the dam into a permanent water storage facility. Fifth, the impacts of operating such a flood detention dam on the environmental and recreational values currently found in the American River canyons could be minimized, particularly if the dam includes increased outlets and operational gates designed to minimize the frequency and depth of canyon inundation and the rate of reservoir drawdown once inundation occurs.

Changed Circumstances

The changed circumstances affecting the Corps' reevaluation of the project are discussed above. They include construction of the SAFCA Local Project, interim reoperation of Folsom Reservoir, implementation of a bank protection project along the lower American River, and Reclamation's concurrent analysis conducted under the ARWRI. The November 1994 Alternatives Report accounted for these changes as follows.

In consideration of the SAFCA Local Project, the Alternatives Report excluded essentially all the Natomas features identified in the 1991 final report from the American River Project and retained only minor improvements along the east levee of the Sacramento River to ensure that Natomas is afforded the same level of protection as the lands in other portions of the American River flood plain. This adjustment eliminated the location benefits

associated with growth in Natomas and substantially all the inundation reduction benefits which were attributed to the Local Project area in the Final Report.

In consideration of Interim Reoperation, the Alternatives Report assumed that in the absence of any congressional action to improve the existing American River flood protection system, SAFCA and Reclamation would indefinitely extend operations under the 1993 Diagram to ensure that the urbanized portions of the American River flood plain continue to be protected to at least the 100-year level. Accordingly, the No-Action Alternative described in the Alternatives Report assumed "permanent reoperation" based on an indefinite extension of the SAFCA-Reclamation implementing agreement.

In consideration of the decision to proceed with a bank protection project in the lower American River, the Alternatives Report assumed the completion of this project under the previously authorized Sacramento River Bank Protection Project.

Finally, in consideration of Reclamation's concurrent pursuit of the ARWRI, the Alternatives Report did not focus on enhancing water supply opportunities in the American River watershed incidental to the flood control objectives of the ARWP. The report recognized that these opportunities would be separately evaluated by Reclamation and presented to Congress in 1996, along with a "bridging document" explaining the relationship between the flood control and water supply alternatives included in each study.

<u>Changed Methodology</u>

In an effort to strengthen the quality of the reevaluation, the Alternatives Report incorporated a new methodology developed by the Corps to reduce the uncertainties associated with projected flood frequencies and with the water-surface elevations and damages associated with rare flood events.

Referred to as "risk and uncertainty analysis," this methodology relies on computer simulations to capture a range of potential outcomes, thus accounting more effectively for (1) the uncertainties associated with projected precipitation and runoff patterns in the American River watershed, due to the relatively limited record on which such projections must be based, (2) the uncertainties associated with the operation of Folsom Dam during a flood event, due to potential mechanical problems with the gates, potential downstream levee problems that would curtail releases, inaccurate inflow data, and (3) the uncertainties associated with the performance of the downstream levee system due to natural changes in the river system over time, manmade incursions into the river channel, and reductions in channel capacity resulting from increased vegetation growth and changes in channel maintenance practices.

This new methodology enabled the Corps to reevaluate the level of flood protection provided by the alternatives studied in connection with the ARWP. Significantly, the Corps concluded that structural and operational modifications to Folsom combined with an increase

in the conveyance capacity of the lower American and Sacramento River levee systems could provide in excess of a 200-year level of flood protection.

Changed Alternatives

Based on the above changes in assumptions and methodology, the Alternatives Report revised the array of alternatives carried forward for detailed analysis in the 1991 final report. First, the Natomas features of these alternatives were eliminated based on completing the Local Project. Second, based on the assumption that interim reoperation would be indefinitely extended in the absence of any congressional action to improve the existing flood control system, alternatives displayed in the December 1991 EIS/EIR were not evaluated. Third, the measures included in the 150-year alternative were reformulated to create four separate alternatives. The "Folsom Modification Alternative" combined the structural modifications of Folsom Dam called for under the 150-year alternative with a modified version of the 1993 Diagram. The "Maximum Release," "Moderate Release," and "Minimum Release" combined these Folsom improvements with variations of the measures included in the 150-year alternative to increase the conveyance capacity of the existing levee system. Fourth, the Alternatives Report upgraded the level of protection provided by the two detention dam alternatives included in the 1991 final report and added a third detention dam alternative with a downsized storage capacity sufficient to provide 200-year protection using the new risk and uncertainty methodology. Finally, minor improvements to the east levee of the Sacramento River were added to all the alternatives to ensure that the lands within the Natomas basin received the same level of protection from the Sacramento River as from the American River.

DRAFT SIR AND DSEIS/SDEIR

In August 1995, the Corps issued the Draft Supplemental Information Report and Draft Supplemental Environmental Impact Statement/Supplemental Draft Environmental Impact Report. The draft SIR evaluated a number of individual flood protection measures for Sacramento. These measures were included in an array of nine flood protection alternatives. Following a public participation process, The Reclamation Board and SAFCA identified two plans to be evaluated in detail. The Corps selected an additional plan to evaluate. These three plans and the No-Action Alternative were considered and associated environmental effects assessed in the draft report.

REVIEW PROCESS

Issuance of the Alternatives Report facilitated the first substantial public and agency review of the status of the ARWP since the adoption of Public Law 102-396 in 1992 and permitted the non-Federal sponsors to reassess their recommendations with respect to the "Selected Plan" advanced to Congress in 1992. This review process produced three significant actions. First, the non-Federal sponsors advanced an additional plan for review.

Designated the "Stepped Release," this alternative combines the storage requirements of the 1993 Diagram with elements of the Maximum and Moderate Release Alternatives displayed in the report. By staggering the timing of design outflows from Folsom, this plan preserves most of the benefits of the Maximum Release Alternative while minimizing the infrastructure costs associated with conveying higher flows to the mouth of the American River and resizing the Sacramento and Yolo Bypass systems to convey these flows to the Delta.

Second, the parties agreed that a DSIR (Draft Supplemental Information Report) would be prepared, and that this document, accompanied by a stand-alone DSEIS/SDEIR (Draft Supplemental Environmental Impact Statement/Supplemental Draft Environmental Impact Report) would be circulated for public review and comment during the summer of 1995.

Third, the non-Federal sponsors indicated that they would make no further decisions with respect to the ARWP until after the public review and comment period. At that point, as in June 1991, the sponsors were in a position to designate a locally preferred plan. This decision allowed the Corps to complete its reevaluation of the ARWP and prepare final feasibility and environmental documents by the end of 1995. The draft document was released for public and agency review in accordance with NEPA and CEQA in August 1995. Comments were solicited and responses developed; these were taken into consideration when the final document was prepared. Comments and responses are presented in appendix M. The Reclamation Board and SAFCA identified the Detention Dam Plan as their selected plan. The document will next proceed to the Washington-level review in anticipation of a congressional decision on the project during the 1996 legislative session.

CHAPTER 3

ALTERNATIVES

This chapter summarizes information on the flood control alternatives and measures considered during the course of the Corps reevaluation of the ARWP. In accordance with the planning principles and guidelines applicable to Federal water resources projects, the alternative which maximizes national economic development benefits (NED Plan) has been designated prior to issuance of the final document.

The Corps, local sponsors, and other interested organizations and individuals identified a variety of measures to increase flood protection in the American River basin. These measures are listed below and compared in table 3-1. Those retained are shown in bold type.

Increase Outlet Efficiency of Folsom Dam and Reservoir

- Normalized use of auxiliary spillway
- **Lower main spillway**
- Conjunctive use of river outlets and main spillway
- **Enlarged river outlets**
- **New river outlets**
- Use of existing diversion tunnel
- **New tunnel outlets**
- Early flood releases prior to storms based on weather forecasts

Increase Flood Releases from Folsom Reservoir

- **Levee modifications**
- Setback levees
- Flood control bypass south of Sacramento

Increase Flood Storage in the American River Basin

- **Flood detention dam at Auburn**
- Existing upstream reservoirs
- Multiple small detention reservoirs
- Offstream storage on Deer Creek
- **Increased Folsom flood storage space**
- **Raised Folsom Dam and Spillway**

TABLE 3-1

Initial Screening of Flood Protection Measures

Measure	Frequency of Storm Controlled to Obj. Release (years)	Construction Cost ($ million)	Flood Control Benefits (B) vs. Costs [a]	Relative Impacts		Potential for Combining with Other Measures	Status
				Environmental	Socioeconomic		
Increase Folsom Dam and Reservoir Outlet Efficiency							
1. *Improved operational response time*	85	< 1	B > C	low	none	high	retained
2. Normalized use of auxiliary spillway	100	20	B > C	low	none	low	dropped
3. *Lower main spillway*	110	60	B > C	low	none	high	retained
4. Conjunctive use of existing river outlets and main spillway	100	5	B > C	low	none	low	dropped
5. *Enlarge river outlets*	105	40	B > C	low	none	high	retained
6. *New river outlets*	105	40	B > C	low	none	high	retained
7. Existing diversion tunnel	105	70	B > C	high	high	high	dropped
8. *New tunnel outlets:* *3 tunnels* *5 tunnels*	 110 110	 140 200	 B > C	 medium	 medium	 high	 retained
9. Early releases	85	N/A	N/A	low	none	low	dropped
Increase Folsom Dam Flood Releases							
1. *Levee modifications:* *130,000 cfs* *145,000 cfs* *180,000 cfs* *235,000 cfs*	 110 120 155 190	 260 350 500 815	 B ≤ C	 medium medium medium high	 low low low high	 high high high high	 retained retained retained dropped
2. Setback levees	155	6,700	B < C	very low	high	low	dropped
3. Flood control bypass south of Sacramento	200	2,100	B < C	high	high	low	dropped
Increase System Flood Storage							
1. *Flood detention dam*	250	750	B > C	high	low	low	retained
2. Existing upstream storage: 50 percent 100 percent	 85 85	 830 975	 B < C	 medium medium	 high high	 low low	 dropped dropped
3. Multiple small detention dams	105	900	B < C	high	low	low	dropped
4. Offstream storage - DeerCreek	200	1,600	B < C	high	high	low	dropped
5. *Modify Folsom flood space:* *475,000-670,000 ac-ft* *535,000-835,000 ac-ft*	 100 100	 120 170	 B > C	 low moderate	 moderate high	 high high	 retained retained
6. Raise Folsom Dam & Spillway: 17 feet 30 feet	130 180	460 660	B < C	medium	medium	low	dropped
7. *Credit surcharge*	95	20	B > C	low	low	high	retained
8. Excavate Folsom Lakebed	130	1,400	B < C	medium	low	low	dropped
Non-Traditional (Nonstructural)							
Flood proofing, evacuation, restriction, and warning	N/A	high	low	low	high	medium	dropped

A description of each measure and why it was deleted or retained for formulation into a flood control alternative is included in chapter IV in the Main Report.

NONSTRUCTURAL MEASURES

Most structural flood damage reduction measures are directed at the source of flooding. Their purpose is to change the direction of floodflows, decrease the area of inundation, alter the timing of floodflows, or store floodflows. In contrast, most nonstructural measures are directed at flood damage reduction of individual property, through the use of land use restrictions and other actions. Nonstructural measures fall into these broad categories: flood proofing, flood plain evacuation, development of restrictions, flood warning. These are discussed in chapter IV of the Main Report. These procedures are currently in force by a coordinated plan involving Federal, State, and community governments.

PLANS CONSIDERED IN DETAIL

A variety of potential flood control measures were evaluated, and a number of action alternatives along with the No-Action Alternative were developed for detailed evaluation. These alternatives are outlined below and summarized in table 3-2. Environmental effects for each alternative are summarized following each alternative outline below.

- **No-Action Alternative**

  - The operational modifications (revised flood control release schedule, revised reservoir storage schedule, and a release schedule for spring refill) to Folsom Reservoir implemented by SAFCA and the U.S. Bureau of Reclamation would continue
  - The Natomas levee project would be completed
  - The West Sacramento Project would be completed
  - The Folsom spillway gate would be repaired
  - Bank protection along the lower American River would be implemented
  - Features of the Folsom Flood Management Plan would be implemented
  - The objective release from Folsom Dam would be maintained at 115,000 cfs

Chapter 6, Environmental Consequences, No-Action Alternative presents the no-action condition. Because no environmental documentation has been prepared to address the impacts of a permanent reoperation, the discussion in chapter 10 describes the likely socioeconomic and environmental effects and required mitigation for changing the flood

Table 3-2
Summary Comparison of Initial Alternatives and Candidate Plans

Item	No-Action	Initial Plans							Candidate Plans		
		Equivalent Storage	Equivalent Protection	Maximum Objective Release	Moderate Objective Release	Minimum Objective Release	Increase Folsom Flood Space	1991 Feasibility Report NED	Folsom Modification	Folsom Stepped Release[2]	Detention Dam
Flood protection (chance of flooding)	1 in 100	1 in 270	1 in 200	1 in 300	1 in 240	1 in 200	1 in 160	1 in 435	1 in 180	1 in 235	< 1 in 500
Probability of passing 200-year storm (%)	16	82	65	83	70	62	50	95	54	68	97
Features											
Folsom Dam & Reservoir											
Flood control space (ac-ft)[1]	400,000/ 670,000	400,000	400,000	475,000/ 810,000	475,000/ 725,000	475,000/ 670,000	475,000/ 655,000	400,000	475,000/ 720,000	400,000/ 670,000	400,000
Objective release (cfs)	115,000	115,000	115,000	180,000	145,000	130,000	115,000	115,000	115,000	145/180,000	115,000
Lower Folsom spillway 15 feet	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Outlets (No. of gates & capacity, cfs)	8 & 30,000	8 & 30,000	8 & 30,000	12 & 100,000	12 & 100,000	12 &100,000	12 & 100,000	8 & 30,000	8 at 70,000	8 & 70,000	8 & 30,000
Lower American River											
American River design capacity (stage, ft)											
Probable nonfailure point	44.5	44.5	44.5	51	49	47	44.5	44.5	46.5	51	46.5
Probable failure point	47.5	47.5	47.5	52	50	48	47.5	47.5	47.5	52	47.5
Stabilize/modify levees (mi)	0	0	0	29	28	25	0	0	24	29	24
Raise/modify bridges	0	0	0	3	3	1	0	0	0	3	0
Downstream American River											
Modify Sacramento Weir & Bypass (ft)	0	0	0	2,700	1,000	600	0	0	0	1,000	0
Stabilize/modify levees (mi)	0	0	0	76	52	43	0	0	0	52	0
Natomas - east bank Sacramento River											
Stabilize/modify levees (mi)	0	12	12	12	12	12	12	12	12	12	12
Upstream storage											
Storage space (ac-ft)	0	545,000	380,000	0	0	0	0	894,000	0	0	894,000
Dam height (ft)	0	435	399	0	0	0	0	508	0	0	508
Flood operation gates	0	20	20	0	0	0	0	20	0	0	20
Raise/modify bridges	0	2	2	0	0	0	0	2	0	0	2

[1]Single number is constant flood space; 400/670, for example, is variable space between 400,000 and 670,000 acre-feet.
[2]Part of Initial Array of Alternatives and Candidate Plans.

control operation at Folsom Dam from a fixed 400,000 acre-feet of storage to the permanent reoperation.

- **Increase Folsom Flood Space Alternative**

  - Incorporate the variable space storage operation initiated under the No-Action Alternative and increase the minimum flood storage maintained in Folsom during the flood season from 400,000 acre-feet to 475,000 acre-feet and the maximum storage from 670,000 acre-feet to 655,000 acre-feet
  - Lower Folsom Dam main spillway 15 feet and replace the five main spillway gates
  - Enlarge the eight river outlets through the main dam
  - Construct four river outlets
  - Modify Folsom Dam and dikes to permit increased surcharge storage and replace three auxiliary spillway gates
  - Modify emergency spillway diagram
  - Strengthen the east levee of the Sacramento River from the Natomas Cross Canal to American River
  - Maintain the objective release from Folsom Dam at 115,000 cfs

Environmental effects from implementation of this alternative would be similar to those described for the Folsom Modification Alternative, but would be somewhat less severe because objective releases from Folsom Reservoir would remain at 115,000 cfs.

- **Folsom Modification Alternative**

  - Incorporate the variable space storage operation initiated under the No-Action Alternative and increase the minimum flood storage maintained in Folsom during the flood season from 400,000 acre-feet to 475,000 acre-feet and the maximum storage from 670,000 acre-feet to 720,000 acre-feet
  - Lower Folsom Dam main spillway 15 feet and replace the five main spillway gates
  - Enlarge the eight river outlets through the main dam
  - Modify Folsom Dam and dikes to permit increased surcharge storage and replace three auxiliary spillway gates
  - Modify emergency spillway diagram
  - Strengthen the east levee of the Sacramento River from the Natomas Cross Canal to American River
  - Maintain the objective release from Folsom Dam at 115,000 cfs
  - Construct 24 miles of slurry wall in Lower American River levees.

Environmental effects from implementation of this alternative are discussed in chapter 7, Environmental Consequences, Folsom Modification Plan.

- **Folsom Stepped Release Alternative**

  - Adopt the 1993 Diagram and revise the Folsom Reservoir Control Manual accordingly (continue using the 400,000 to 670,000 acre-feet of variable space storage operation)
  - Lower Folsom Dam main spillway 15 feet and replace the main spillway gates
  - Enlarge the eight river outlets through the main dam
  - Modify Folsom Dam and dikes to permit increased surcharge storage, replace three auxiliary spillway gates, and modify emergency spillway diagram
  - Implement levee and related channel modifications along lower American River
  - Increase the objective release from Folsom Dam to a maximum of 180,000 cfs depending on Folsom Reservoir storage and inflow
  - Construct 25.6 miles of slurry wall in lower American River levees.
  - Lengthen Sacramento Weir and widen Sacramento Bypass
  - Raise and strengthen levees in the Yolo Bypass
  - Strengthen east levee of the Sacramento River from the Natomas Cross Canal to the American River
  - Construct a recreation trail along the lower American River near Richards Boulevard and new park facilities near Highway 160 (Gateway Park)
  - Restore 144 acres of degraded habitat along the lower American River near Woodlake Avenue and near the Urrutia Gravel Mining operation.

Environmental effects from this alternative are presented in chapter 8, Environmental Consequences, Stepped Release Plan.

- **1991 Feasibility Report NED Alternative**

  - Construct a flood control detention dam with a maximum capacity of 894,000 acre-feet near Auburn
  - Relocate Highway 49 and strengthen Ponderosa Way
  - Strengthen the east levee of the Sacramento River from Natomas Cross Canal to the American River
  - Eliminate the variable space storage operation initiated under the No-Action Alternative and revert Folsom Reservoir to a fixed space storage operation (400,000 acre-feet)
  - Maintain the objective release from Folsom Dam at 115,000 cfs

Environmental effects from this alternative would be similar to those associated with the Detention Dam discussed below. Construction of a slurry wall is not part of the 1991 Feasibility Report NED plan.

- **Detention Dam**

    - Construct a flood control detention dam with a maximum capacity of 894,000 acre-feet near Auburn
    - Relocate Highway 49 and strengthen Ponderosa Way
    - Strengthen the east levee of the Sacramento River from Natomas Cross Canal to the American River
    - Eliminate the variable space storage operation initiated under the No-Action Alternative and revert Folsom Reservoir to a fixed space storage operation (400,000 acre-feet)
    - Maintain the objective release from Folsom Dam at 115,000 cfs
    - Construct 24 miles of slurry wall in lower American River levees.

Environmental effects from this alternative are presented in chapter 9, Environmental Consequences, Detention Dam Plan.

- **Maximum Objective Release Alternative**

    - Incorporate the variable space storage operation initiated under the No-Action Alternative and increase the minimum flood storage maintained in Folsom during the flood season from 400,000 acre-feet to 475,000 acre-feet and the maximum storage space from 670,000 acre-feet to 810,000 acre-feet
    - Lower Folsom Dam spillway 15 feet and install five new main spillway gates
    - Enlarge the eight existing outlets through the main dam and construct four new river outlets
    - Modify Folsom Dam so as to permit increased surcharge storage, replace three auxiliary spillway gates, and modify emergency spillway diagram
    - Implement levee and related channel modification along lower American River
    - Increase Folsom Dam objective release to 180,000 cfs
    - Lengthen Sacramento Weir and widen Sacramento Bypass
    - Raise and strengthen levees in the Yolo Bypass
    - Strengthen east levee of the Sacramento River along the western flank of Natomas
    - Construct a recreation trail along the lower American River near Richards Boulevard and new park facilities near Highway 160 (Gateway Park)
    - Restore 144 acres of degraded habitat along the lower American River near Woodlake Avenue and near the Urrutia Gravel Mining operation.

Modifications to the dam outlets (spillway and flood control sluices) would have minor adverse effects on natural resources at the dam. Some adverse effects to air quality and adverse noise increases would result. These would be mitigated with proper vehicle maintenance and sound barriers.

Improvements and enlargements of the levee system along the lower American River would wildlife habitat, including riparian and scrub-shrub. Widening the Sacramento Bypass

would require acquisition of agricultural land and grassland habitat. The improvements to levees in the Yolo Bypass would affect habitat, including agricultural fields, grassland, emergent marsh, and riparian habitat cover types. Mitigation for these losses would include planting riparian habitat along the lower American River. Habitat improvements would be made in the Sacramento Bypass to compensate for losses in the Yolo Bypass. Grassland acres that were disturbed for levee improvements would be reseeded with native vegetation.

Increasing the level of reoperation of Folsom from 400,000/670,000 acre-feet to 475,000/810,000 acre-feet is not expected to have large impacts on resources. By seasonally drawing down the reservoir to provide at least 475,000 acre-feet of space from mid-November to mid-March, the reservoir would be about 12 feet lower than the without-project condition under most situations. This would have some minor effects on delivery of local water supply and on hydropower production, but since this would be during winter, there would be few adverse effects to recreation. This increased storage capacity would also result in a reduction in the total water supply capacity of the CVP by about 14,000 acre-feet per year. This maximum drawdown would not change from the without-project condition. Therefore, few additional adverse effects would be expected to fisheries and vegetation in the lower American River.

- **Moderate Objective Release Alternative**

    - Incorporate the variable space storage operation initiated under the No-Action Alternative and increase the minimum storage maintained in Folsom during the flood season from 400,000 acre-feet to 475,000 acre-feet and the maximum from 670,000 to 725,000 acre-feet
    - Lower Folsom Dam main spillway 15 feet, enlarge eight existing river outlets, and construct four new river outlets through the auxiliary spillway
    - Modify Folsom Dam so as to permit increased surcharge storage, replace three auxiliary spillway gates, and modify emergency spillway diagram
    - Implement levee and related channel modifications along lower American River
    - Increase the objective release from Folsom Dam to 145,000 cfs
    - Lengthen Sacramento Weir and widen Sacramento Bypass
    - Raise and strengthen levees in the Yolo Bypass
    - Strengthen the east levee of the Sacramento River from Natomas Cross Canal to the American River
    - Construct a recreation trail along the lower American River near Richards Boulevard and new park facilities near Highway 160 (Gateway Park)
    - Restore 144 acres of degraded habitat along the lower American River near Woodlake Avenue and near the Urrutia Gravel Mining operation.

Major environmental effects of the plan and potential features to mitigate them would be similar to those for the Maximum Objective Release Alternative. This moderate-release plan would reduce effects in the lower American River to riparian scrub-shrub. Widening the Sacramento Bypass and modifying levees in the Yolo Bypass would affect emergent

marsh and riparian systems. Mitigation would include planting riparian habitat along the lower American River and riparian and wetland habitat in the Sacramento Bypass. The increased seasonal storage capacity in Folsom Reservoir would result in a reduction in the water supply capacity of the CVP by an estimated 13,000 acre-feet per year. Hydropower generation and recreation use at the lake would also by slightly reduced.

- **Minimum Objective Release Alternative**

  - Incorporate the variable space storage operation initiated under the No-Action Alternative and increase the minimum flood storage maintained in Folsom during the flood season from 400,000 acre-feet to 475,000 acre-feet (475,000 acre-feet to 670,000 acre-feet)
  - Lower Folsom Dam main spillway 15 feet, enlarge eight existing river outlets, and construct four new river outlets through the auxiliary spillway
  - Modify Folsom Dam so as to permit increased surcharge storage, replace three auxiliary spillway gates, and modify emergency spillway diagram
  - Implement levee and related channel modifications along lower American River
  - Increase Folsom Dam objective release to 130,000 cfs
  - Lengthen Sacramento Weir and widen Sacramento Bypass
  - Raise and strengthen levees in the Yolo Bypass
  - Strengthen the east levee of the Sacramento River from Natomas Cross Canal to the American River
  - Construct a recreation trail along the lower American River near Richards Boulevard and new park facilities near Highway 160 (Gateway Park)
  - Restore 144 acres of degraded habitat along the lower American River near Woodlake Avenue and near the Urrutia Gravel Mining operation.

Environmental effects of the plan and measures included to mitigate the effects would be similar to the previous two plans. The relatively higher amount of seasonal storage could begin to affect water temperatures released to the lower American River. Potential adverse effects to fisheries in the lower American River would be compensated by modifying, the temperature shutters at Folsom Dam to control temperatures of releases. The increased seasonal storage capacity in Folsom Reservoir would result in an annual reduction in the water supply capacity of the CVP of about 12,000 acre-feet. Hydropower generation and recreation use at the lake would also be slightly reduced.

- **Equivalent Storage Alternative**

  - Construct a flood control detention dam near Auburn with a maximum capacity of 545,000 acre-feet
  - Relocate Highway 49 and strengthen Ponderosa Way
  - Strengthen the east levee of the Sacramento River from Natomas Cross Canal to the American River

- ▸ Eliminate the variable space storage operation initiated under the No-Action Alternative and revert Folsom Reservoir to a fixed space storage operation (400,000 acre-feet)

The plan would result in effects in the American River canyon due to construction and operation of the detention dam. Vegetation would be lost as a result of dam construction and replacing Highway 49. Operation of the detention dam would result in the loss of upland vegetation over the project life as a result of vegetation mortality.

Wildlife in the canyon would be affected when their habitat is inundated. The more mobile animals would be able to flee from the rising floodwaters, but more sedentary animals or animals in hibernation could be lost. Although some animals would be lost following each flood, repopulation would take place over the next several years. The operation of the detention dam would also periodically affect habitat of the threatened valley elderberry longhorn beetle.

Mitigation for the loss of approximately 1,228 acres of vegetation (and associated wildlife habitat values) would involve acquiring and preserving about 2,600 acres of land. These figures include 100 acres for mitigating lost habitat for the beetle.

- **Equivalent Protection Alternative**

  - ▸ Construct a flood control detention dam near Auburn with a maximum capacity of to 380,000 acre-feet
  - ▸ Relocate Highway 49 and strengthen Ponderosa Way
  - ▸ Strengthen the east levee of the Sacramento River from Natomas Cross Canal to the American River
  - ▸ Eliminate the variable space storage operation initiated under the No-Action Alternative and revert Folsom Reservoir to a fixed space storage operation (400,000 acre-feet)

The plan would result in impacts in the American River canyon due to construction and operation of the detention dam similar to those of the equivalent storage plan. The smaller footprint of the dam and smaller detention storage area would reduce mitigation needs. Mitigation would consist of purchasing and preserving land. This includes mitigating lost habitat for the threatened valley elderberry longhorn beetle.

The plans described above were modified and became the candidate plans proposed for implementation. Following is a more detailed description of the No-Action Alternative and the Folsom Modification, Stepped Release, and Detention Dam Plans. The environmental impacts of these alternatives are discussed in chapters 7, 8, 9, and 10. These alternatives are representative of the two smaller flood detention dams and other increased objective release plans; consequently, these plans have not been included in the following

NO-ACTION ALTERNATIVE

Under this plan, in the absence of congressional action on a long-term improvement project for the American River, SAFCA and Reclamation would take whatever steps are necessary to ensure that their agreement on interim reoperation of Folsom Dam and Reservoir is indefinitely extended. Therefore, under this plan, Folsom Dam and Reservoir flood operations would be conducted in accordance with the flood control diagram referenced in the SAFCA-Reclamation interim reoperation agreement (1993 Diagram). This diagram has three essential elements: (1) a flood control release schedule designed to permit simultaneous use of the existing five main spillway bays and eight river outlets until the objective release is reached; (2) a reservoir storage schedule which provides for a minimum winter season flood control allocation of 400,000 acre-feet of empty space and a maximum of 670,000 acre-feet of empty space, depending on the space available in three upstream reservoirs (Union Valley, Hell Hole, and French Meadows); and (3) a release schedule for the spring refill. Each of these elements is explained below. To protect the environmental and recreational resources in the lower American River, the Interim Reoperation implementing agreement further obligates Reclamation to ensure that Folsom Reservoir releases during the spring refill period are at least equal to the lesser of (1) the releases that would have been made if Folsom had continued to be operated in accordance with the 1986 Diagram or (2) the releases designated by Judge Hodge in deciding the matter of Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge Decision).

The 1993 Diagram requires that water stored in the designated flood control space be released as rapidly as possible. The maximum specified release is 115,000 cfs. However, during relatively small flood events, the outflow would be limited to the maximum inflow. Any change in outflows is limited to 30,000 cfs per 2-hour period when inflows are increasing and 10,000 cfs per 2-hour period when inflows are decreasing. When the spillway gates and river outlets are operating simultaneously (between elevation 423.6 feet and 447 feet), the gates on the river outlets would be set in a 60 percent open position to avoid damage to the spillway and outlet conduits by cavitation.

Reclamation would be required to reduce the water conservation pool in Folsom Reservoir to no more than 575,000 acre-feet full (400,000 acre-feet empty) at the outset of each flood season if the three upstream reservoirs have 200,000 acre-feet or more empty space at that time. This target must be met by November 17 and maintained thereafter unless, based on a daily evaluation, the storage space upstream falls below 200,000 acre-feet. At that point, the Folsom Reservoir pool must be reduced in accordance with the storage schedule. For example, a decline to 175,000 acre-feet of empty space upstream requires a reduction in storage in Folsom Reservoir to 550,000 acre-feet, while a decline to 130,000 acre-feet of empty space upstream requires a reduction in storage in Folsom Reservoir to 475,000 acre-feet. For purposes of calculating the total amount of creditable

empty space in the upstream reservoirs, French Meadows would be deemed to have a maximum of 45,000 acre-feet of creditable storage, Hell Hole 80,000 acre-feet, and Union Valley 75,000 acre-feet. Empty space in excess of these amounts at each reservoir would not be creditable.

FOLSOM MODIFICATION PLAN

This plan would increase protection to most of Sacramento and Natomas by reducing the possibility of flooding to a 1 in 180 chance of occurring in any year by increasing the variable space allocated to flood control under the 1993 Diagram from 400,000/670,000 acre-feet to 475,000/720,000 acre-feet, implementing structural modifications to Folsom Dam, and strengthening the American River levees and a portion of the Sacramento River east levee. These measures are described below. This alternative is a modification of the Increase Folsom Flood Space Alternative discussed in the Main Report.

Folsom Storage

Under the Folsom Modification Plan, a new flood control diagram would be developed increasing the space allocated to flood control from 400,000/670,000 acre-feet to 475,000/720,000 acre-feet, depending on storage available in the upstream reservoirs.

Folsom Dam Modifications

To ensure efficient use of the space dedicated to flood storage in the reservoir, the Folsom Modification Plan also includes provisions for structurally modifying Folsom Dam. These modifications include lowering the Folsom Dam main spillway by 15 feet, enlarging the eight river outlets through the main dam, and implementing the improvements necessary to create additional surcharge storage in the reservoir. These modifications would permit Folsom operators to make larger releases earlier in a flood event, thereby preserving as much flood control storage space as possible in the reservoir.

American River Levee Improvements

To increase the reliability of the American River with the 115,000 cfs objective release, a 24-mile-long slurry wall would be constructed in the Federal and non-Federal levees along both sides of the lower American River.

Sacramento River Levee Improvements

This plan includes approximately 12 miles of minor improvements to strengthen the east levee of the Sacramento River along the western flank of Natomas downstream from the mouth of the Natomas Cross Canal.

STEPPED RELEASE PLAN

This plan would increase the flood protection to Sacramento by reducing the probability of flooding due to levee failure to 1 in 230 in any year by incorporating permanent reoperation of Folsom Reservoir (based on the 1993 Diagram) into the existing flood control system, modifying Folsom Dam to ensure efficient use of this storage space, and increasing the capacity of the downstream levee system. These improvements are described below.

Folsom Storage

Under this plan, the Secretary of the Army would adopt the 1993 Diagram for Folsom Reservoir.

Folsom Dam Modifications

This plan would include the same Folsom Dam modifications previously described in connection with the Folsom Modification Plan. These include lowering the main spillway 15 feet and replacing the five main spillway gates, enlarging the eight river outlets, and strengthening portions of the dam and dikes and enlarging the auxiliary spillway gates to permit increased surcharge storage.

Downstream Improvements

The Stepped Release would include improvements to accommodate increased objective releases from Folsom Dam up to a maximum of 180,000 cfs. The magnitude of these releases would depend on inflow and water storage in the reservoir. For floods greater than about a 20-year event but less than about a 175-year, the objective release would be 145,000 cfs. For floods greater than a 175-year event but less than about the 220-year, the objective release would be 180,000 cfs. The improvements required to accommodate these higher releases would include raising and strengthening portions of the existing American River levee system, raising Howe Avenue and Guy West bridges and modifying the Union Pacific Railroad trestle, and modifying interior drainage facilities and other infrastructure in the flood plain. A 25.6-mile-long slurry wall would be constructed in the Federal and non-Federal levees along both sides of the lower American River to increase levee reliability. To

avoid higher flood stages in the Sacramento River downstream from the mouth of the American River, it would be necessary to lengthen the Sacramento Weir and widen the Sacramento Bypass by 1,000 feet and raise and strengthen levees in the Yolo Bypass to ensure that the flood risk to the lands protected by these levees is not worsened.

Sacramento River Levee Improvements

This plan would include the same improvements along the east levee of the Sacramento River previously described in connection with the Folsom Modification Plan.

Restoration Plan

The Stepped Release Plan includes a restoration plan consisting of wetland/riparian features in two areas of the American River Parkway: the Woodlake area, which extends from the mouth of the NEMDC (Natomas East Main Drainage Canal) to Cal Expo, and the Urrutia property adjacent to Discovery Park.

Woodlake Area. Restoration in the Woodlake area would include development of a slough/wetland complex on approximately 37 acres of land owned and managed by Sacramento County and conversion of 50 acres of non-oak upland habitat to riparian and wetland plant communities. Material excavated to create this restoration feature would be used to provide fill for a portion of the levee improvements called for under the Stepped Release plan.

Urrutia Property. Restoration on the Urrutia property would consist of creating wetland/riparian habitat on land adjacent to the 57-acre pond which dominates the site. This pond has been excavated over time as part of mining on the property. Restoration would involve excavation and fill along the northern edge of the pond to create a series of shallow shelves extending from the water's edge along a gently sloping berm to adjacent high ground. These shelves would support an assemblage of emergent marsh habitat, and the sloping berm would be planted with riparian vegetation.

Recreation Plan

The Stepped Release Plan also includes a recreation plan consisting of an 8-mile-long bicycle/pedestrian trail along the south side of the American River linking Tiscornia Park near the Sacramento-American River confluence to California State University, Sacramento, and a gateway park on the north side of the river in the American River Parkway adjacent to the Highway 160 overcrossing.

DETENTION DAM PLAN

This plan would provide occupants of the American River flood plain greater flood protection by reducing the probability of flooding due to levee failure to less than 1 in 500 chance in any year through construction of a flood detention dam near Auburn. The improvements included in this plan are described below.

Flood Detention Dam on the American River

The main feature of the Detention Dam Plan is a flood detention dam on the North Fork American River at mile 47.2 near Auburn, near the site of Reclamation's authorized multipurpose Auburn Dam Project. The dam would be a peak-flow detention dam of concrete gravity design that would not permanently store water. An overview of the Auburn area, damsite plan, outlet works tunnel intake structure, and dam and spillway profile and sections are shown on plates 17 through 19 in the Main Report.

In most years, no water would be impounded behind the dam. It is expected that some water would begin to be impounded for short periods with about a 25-year event. However, during extremely rare events (less frequent than 1 in 500 in any year), up to 894,000 acre-feet of water could be impounded for several hours. During such an event, the filling and emptying of the reservoir would take up to 20 days.

During a design flood, water would reach a maximum elevation of 942 feet and cover about 5,450 acres. From streambed, the dam would be about 508 feet high and detain floodwaters up to 452 feet deep. The crest of the dam would be 2,700 feet long (about 1/2 mile). The dam would be about 400 feet wide at its base, decreasing to about 25 feet at the dam crest. The foundation of the dam would extend about 50 feet below the surface of the streambed.

Construction of the dam would require about 6 million cubic yards of aggregate. The aggregate would include material deposited in the riverbed in 1986 from the old cofferdam and an underground amphibolite mine at the damsite.

Dam construction would require removing approximately 2 million cubic yards of material from the foundation. Any unsuitable material would be placed in the foundation keyway excavated in connection with the multipurpose project or banked at the foot of the uncompleted boat ramp paralleling Salt Creek.

Outlet capacity for the structure would be provided by 20 rectangular box sluices 5 feet by 10.5 feet. The maximum release of the outlet works would be about 77,000 cfs. The sluices would include operational gates.

The tunnel constructed by Reclamation for its Auburn Dam Project would continue diverting streamflows around the damsite during construction. Following completion of the detention dam, a watertight bulkhead gate would be installed to seal the entrance to the tunnel.

A spillway is provided for dam safety in the event a flood is greater than the design storm. The 540-foot-long spillway would be located in the center of the dam and have a design capacity of 810,000 cfs. Floodwater would first pass over the spillway when the water level behind the dam reached 56 feet from the top of the dam.

About 6,000 acres of land in the Auburn area would be required for construction, operation, and maintenance of the proposed dam and related facilities, including 47 acres to relocate Highway 49. The land would include 5,267 acres in Federally owned property, 8 acres in State ownership, and 757 acres currently held in private ownership. All Federally owned property would remain in Federal ownership.

The Corps would obtain a joint-use permit on 260 acres of Federal land for the dam foundation and appurtenances. Within the detention area, the non-Federal sponsor would obtain temporary easements on 99 acres for construction of the dam and permanent road easements on 52 acres for road replacements. The non-Federal sponsor and the Corps would obtain flowage easements on 5,932 acres. A total of 1,891 acres would be acquired in the canyon and 2,962 acres in Yuba River basin in fee for fish and wildlife mitigation.

Allowance for a "dead pool" space for sediment would not be included in the dam, primarily because only small amounts of sediment would be expected to reach the facility. Most of the sediment that would be transported to the damsite would pass through the outlet works.

Bridge Across the North Fork American River

The portion of Highway 49 relocated would be about 1.8 miles long, with a bridge about 0.6 mile long crossing the North Fork at river mile 49.1. The replacement would contain no enhancements and make no allowance for future traffic projections. The right-of-way would require about 47 acres. From about the town of Cool, the relocated route would extend northwest across the North Fork American River at about elevation 1,000 feet. The alignment would intersect High Street in Auburn.

The non-Federal sponsor is responsible for all relocations. State regulations may require route adoption studies to review plans for upgrading and realigning the highway in accordance with future traffic projections. These studies may result in the selection of a route other than the one described above. If the State ultimately selects a plan other than

this, separate environmental and related analyses will have to be completed by the State to proceed with that plan.

Levee Improvements

As with all the plans carried forward for detailed analysis, the Detention Dam Plan includes strengthening the lower American River levee system by constructing a 24-mile-long slurry wall in the core of the Federal levee on both sides of the river and strengthening the east levee of the Sacramento River along the western flank of Natomas (12 miles) to maximize the flood protection for Natomas.

Folsom Dam Operations

The storage created under the Detention Dam Plan would return flood control operations at Folsom Dam to the 1986 Diagram of 400,000 acre-feet of fixed storage space and an objective release of 115,000 cfs.

CHAPTER 4

AFFECTED ENVIRONMENT

This chapter describes the conditions in the study area, including the physical elements of the environment and the socioeconomic and environmental conditions that could be affected by the project.

DESCRIPTION OF PROJECT AREA

For purposes of assessing the environmental consequences of the proposed action and alternatives, the project area will consist of the following subareas:

- Upper American River. The area encompassing the American River Watershed upstream from Folsom Reservoir, including (1) the Auburn Dam site, (2) the 42,000 acres of land around the damsite which encompass the Auburn State Recreation Area and lie within the Bureau of Reclamation's authorized Auburn Dam project limits, (3) areas along the South Fork of the American River which are suitable for mitigating impacts to fish and wildlife resources, (4) communities in Placer and El Dorado Counties surrounding the Auburn State Recreation Area, and (5) the three largest non-Federal reservoirs in the watershed—Union Valley, Hell Hole, and French Meadows.

- Natomas. The area encompassing the east levee of the Sacramento River from the mouth of the Natomas Cross Canal to the mouth of the American River, a portion of the north levee of the American River, the Natomas East Main Drainage Canal and Pleasant Grove Creek Canal, and the Natomas Cross Canal.

- Folsom Reservoir Area. The area encompassing Folsom Dam and Reservoir and including the stilling basin downstream from the dam, the residential development surrounding the dam and reservoir, and the footprint of the reservoir which would be subject to periodic changes in surface elevation.

- Lower American River. The area encompassing (1) the American River Parkway and (2) the flood plain of the lower American River from Folsom Dam downstream to the confluence with the Sacramento River.

- Upper Sacramento River. The area encompassing (1) Shasta and Keswick Reservoirs, (2) the upper reach of the Sacramento River from the Fremont Weir to Keswick Reservoir, (3) Clair Engle Reservoir and the Trinity River, and (4) Oroville Dam and

Reservoir and the Feather River from Thermolito Afterbay to the confluence with the Sacramento River.

- Downstream from American River. The area encompassing (1) the Sacramento River downstream from the mouth of the Natomas Cross Canal, (2) the Yolo Bypass and the lands immediately adjacent to the bypass, (3) the Sacramento Weir and Bypass and adjacent lands, and (4) the Sacramento-San Joaquin Delta, the roughly triangular area bounded by the City of Sacramento on the north, Pittsburgh on the west, Tracy to the south, and Stockton to the east.

- Yuba River Area. The area encompassing the Yuba River upstream from Englebright Dam. The area would be used to provide mitigation for impacts to vegetation affected by construction of the Detention Dam Plan.

PHYSICAL CONDITIONS

TOPOGRAPHY AND CLIMATE

The American River basin above Folsom Dam is very rugged, with rocky slopes, V-shaped canyons, and few flat valleys or plateaus. Elevations range from 10,400 feet at the headwaters to about 200 feet at Folsom Dam; the basin slope averages 80 feet per mile. The upper third of the basin has been intensely glaciated and is alpine, with bare peaks and ridges, considerable areas of granite pavement, and only scattered areas of trees. The middle third is dissected by canyons, which have reduced the interstream areas to narrow ribbons of relatively flat land. The lower third consists of low rolling foothills and flood plain areas near the confluence with Sacramento River.

The climate of the study area is characterized by cool, wet winters and hot, dry summers. The major portion of the seasonal rainfall occurs in two or three of the winter months. The seasons are so distinctly different that the period from May to October may be termed the dry season and November to April the wet season. Micro-climates within the study area are closely associated with the topography of the area. There is a marked difference in temperature and precipitation within short distances, (that is, between valley and foothill areas). Precipitation varies throughout the area, ranging from 16 to 20 inches on the valley floor to about 70 inches in the higher mountains above Folsom Dam and Reservoir. The annual precipitation is concentrated almost entirely (90 percent of the runoff-producing precipitation) during the winter storm season (from November through March). Precipitation usually falls as rain up to about the 5,000-foot elevation and as snow at higher elevations. However, some storms may produce rain up to the highest elevations of the basin. Conversely, at rare intervals, snow may fall as low as the valley floor.

Temperatures in the valley are high in the summer and moderate in the winter. In the mountains, temperatures are generally lower at higher elevations. The summers are

moderate at higher elevations, and the winters are severe. Peak wind velocities in California are generally associated with winter-type storm fronts, although the sustained winds are strongest in the summer. The prevailing wind direction in the lower American River basin is from the south and southeast during April through September and from the north during October through March. The most important storms affecting the study area are cyclonic wave disturbances along the polar front that usually originate in the vicinity of the Aleutian Islands. The normal trajectory of the waves along this front is to the south and east from the Pacific Ocean to the west coast. In the summer, this frontal zone is far to the north, and the accompanying precipitation seldom reaches as far south as California. The air which reaches the region is generally stable. Thunderstorms rarely cause rainfall in the project area. From October to April, the frontal zone moves southward, moving the cyclonic wave disturbances over California.

HYDROLOGY

The American River basin encompasses a 1,875-square-mile drainage area behind Folsom Dam. An average of 2.7 million acre-feet of runoff drains annually from this basin. Total reservoir storage of the American River basin is 75 percent of the mean annual runoff, or about 2 million acre-feet. Folsom Reservoir is the largest American River reservoir and has a capacity of 975,000 acre-feet. Since the completion of Folsom Dam in 1955, the flow regime below the dam has been significantly changed.

Flood-producing runoff occurs primarily during October through April, and it is usually most extreme during November through March. During April through July, the rain/flood season is followed by a period of moderately high runoff from snowmelt. Runoff from snowmelt usually does not result in flood-producing flows, but ordinarily is adequate to fill the reservoir's empty space. Empty space is available in the reservoir because this space is reserved for flood control during the winter months. Detailed information can be found in the Hydrology appendix.

GEOLOGY, SEISMOLOGY, AND SOILS

The American River basin is in the central Sierra Nevada. The lower portion of the basin, which includes Folsom Dam and the Auburn Dam site, lies within a foothill metamorphic belt 30 to 50 miles wide and 250 miles long. The east, the upper portion of the basin, lies within the Sierra Nevada granitic batholith, which has intruded into and makes the eastern margin of the metamorphic belt. The metamorphosed volcanic and sedimentary rocks in the lower portion of the basin range in age from 140 to more than 300 million years old. These strata are complex, faulted and folded. Following this faulting and folding, these strata were eroded to a landscape of moderate relief. Volcanic and sedimentary rocks were deposited over this surface. The present drainage patterns were formed by regional uplift and western tilting, which induced erosion and canyon cutting. Within the metamorphic belt, the Foothill Fault system, a series of subparallel, northwest trending vertical faults, includes

at least two major fault zones. The easternmost is the Melones Fault zone, and the westernmost is the Bear Mountains Fault zone, which intersects the main body of Folsom Reservoir. This system is geologically old (200 million years); the last major seismic movement was about 140 million years ago.

Geologic formations underlying the Sacramento Valley include igneous, metamorphic, and sedimentary rock types, which range in age from precretaceous to recent. The valley is situated on vast alluvial deposits that have slowly accumulated over the last 100 million years. The materials have been derived from the surrounding uplands; transported by major streams; and deposited in successive clay, silt, sand, and gravel layers on the valley floor.

The area below Folsom Dam is part of the Great Valley Geomorphic province of California. The broad valley was filled with erosion debris that originated in the surrounding mountains. Most soils in the area are recent alluvial flood plain soils. They consist of unconsolidated deposits of clay, silt, and sand that occur as flood plain deposits. Fresh alluvium is deposited with each floodflow, particularly within the bypasses.

Sedimentation rates in the American River basin and adjacent river basins are relatively low due to limited development, the general shallowness of soils, a low rate of upstream erosion, and numerous containment basins. Estimates of the annual sediment yield range from 0.1 to 0.3 acre-foot per square mile. Since the completion of Folsom Dam in 1955, only about 2 percent of the reserved sediment storage space in the reservoir has been filled.

SOCIOECONOMIC PROFILE

FLOOD CONTROL

Sacramento River Flood Control Project

The SRFCP (Sacramento River Flood Control Project) was originally authorized by the Flood Control Act of 1917 and subsequently modified by various Flood Control and/or River and Harbor Acts in 1928, 1937, and 1941. The project was constructed by the Corps between 1918 and 1968; the State is the non-Federal sponsor. The principal features, a comprehensive system of levees, overflow weirs, drainage pumping plants, and flood bypass channels, are on or adjacent to the Sacramento River and the lower reaches of its main tributaries from Ord Bend downstream to Collinsville, about 184 miles. This includes the levees along lower American River from the confluence to Cal Expo on the north bank and to Mayhew drain on the south bank.

This project operates by containing potential floodwaters of streams, river channels, and sloughs between levees and diverting those floodwaters into the Butte Basin and Sutter and Yolo Bypasses. Approximately 1,000 miles of levees provide flood protection to Yuba

City, Marysville, Sacramento, West Sacramento, and numerous smaller communities; highways, railroads, and airports; and about 800,000 acres of agricultural lands. During its history, the project has prevented billions of dollars in flood damage.

American River Flood Control Project

The American River Flood Control Project was constructed by the Corps in 1958 and is operated and maintained by the State of California. The project consists of a levee extending about 7 miles from high ground near Carmichael downstream along the north side of the American River to a previously existing levee ending near the Interstate Business 80 crossing.

Folsom Dam and Reservoir

Folsom Dam and Reservoir is a multipurpose water project constructed by the Corps and operated by Reclamation as part of the CVP. Folsom Dam regulates runoff from about 1,875 square miles of drainage area. Folsom Reservoir has a normal full pool storage capacity of 975,000 acre-feet with a minimum seasonally designated flood control storage space of 400,000 acre-feet. The reservoir provides flood protection for the Sacramento area; water supplies for irrigation, domestic, municipal, and industrial uses; and hydropower. The reservoir also provides extensive water-related recreational opportunities, water quality control in the Delta, and maintenance of flows stipulated to balance anadromous and resident fisheries, wildlife, and recreational considerations in and along the lower American River.

The Regional Director of the Mid-Pacific Region of the U.S. Bureau of Reclamation, based in Sacramento, California, has overall operation responsibility for Folsom and Nimbus Dams. The Folsom facilities are operated to secure the greatest practicable benefits from flood control and other authorized purposes; however, the limited capacity of the Folsom Dam spillway at intermediate storage levels constrains efficient utilization of the space allocated to flood control in the reservoir. Because sufficient head is not available at the spillway gates, the maximum design release of 115,000 cfs through the five main spillway gates, in combination with powerplant releases, is not possible until the reservoir pool reaches elevation 445.6 feet (790,000 acre-feet). At this elevation the storage encroaches into the flood control space by about 180,000 acre-feet.

A second operational constraint is the inability to release water above the objective release of 115,000 cfs without a significant risk of levee failure. The limitations of the downstream levees were evident during the February 1986 flood when considerable erosion and levee boils occurred due to several days of flows over 115,000 cfs.

Hydropower Reservoirs

Approximately 820,000 acre-feet of storage capacity exists in American River basin reservoirs upstream from Folsom Reservoir. These facilities have at times proved beneficial in attenuating inflow to Folsom Reservoir, although the extent of this beneficial effect is

limited by the following factors: (1) these reservoirs were constructed and are operated for hydropower generation and water supply (they do not include dedicated space or physical features for flood control); (2) they control only 14 percent of the drainage area; (3) they are disproportionately concentrated in the upstream area of the Middle Fork American River, and (4) their impact occurs only during the early part of the runoff period because, once filled, they are not effective in reducing flood volume and peak flow. Nevertheless, recent studies by the Corps indicate that under current operations, the three largest upstream reservoirs (French Meadows, Hell Hole, and Union Valley) could provide as much as 200,000 acre-feet of creditable flood storage.

WATER SUPPLY

Central Valley Project

The CVP was authorized in 1937, and Reclamation constructed the CVP and now operates it for water supply, hydropower generation, flood control, navigation, fish and wildlife, recreation, and water-quality control. The CVP service area extends about 430 miles through much of California's Central Valley, from Clair Engle and Shasta Reservoirs in the north to Bakersfield in the south. The CVP also includes the San Felipe Unit, which delivers water to the Santa Clara Valley. In 1988, CVP deliveries totaled about 5.3 million acre-feet, or about 75 percent of total contracted deliveries of 7.1 million acre-feet. These deliveries included almost 1.9 million acre-feet to the Sacramento River Service Area, 285,000 acre-feet to the American River Service Area, and about 3.1 million acre-feet to the Delta Export Service Area.

The CVP is operated as an integrated system to meet multiple authorized purposes. Minimum fishery releases to the lower American River from Nimbus Dam are made in accordance with water rights Decision No. 893 (D-893) by the SWRCB. The SWRCB increased the D-893 minimum release schedule in its Decision 1400 (D-1400). This decision was applied to the water rights permit for Auburn Dam and does not apply to the operation of Folsom and Nimbus Dams. However, Reclamation voluntarily operates Folsom and Nimbus Dams to meet the D-1400 minimum fishery flows, except during droughts when the release pattern is reduced below the D-1400 requirements (but very seldom to flows as low as allowed by D-893). For further background information on the CVP, see the "Long-Term Central Valley Project Operations Criteria and Plan; CVP-OCAP," October 1992, commonly referred to as the "OCAP Report."

State Water Project

Thirty agencies throughout California have contracted with the SWP (State Water Project) for an annual total of 4.2 million acre-feet of water. Existing SWP facilities can supply less than 2.4 million acre-feet during droughts. Additional facilities are planned to increase the supply. The Coastal Branch Aqueduct is currently under construction and will serve San Luis Obispo and Santa Barbara Counties; authorized, but not yet built, are

conveyance facilities to improve transfer of water across the Delta and treatment facilities to remove salty agricultural drainage water from the San Joaquin Valley.

The initial facilities of the SWP, completed in 1973, include 18 reservoirs, 17 pumping plants, 8 hydroelectric powerplants, and 550 miles of aqueducts and pipelines. Water from the Feather River watershed and the Delta is captured and conveyed to areas of need in the San Francisco Bay area, the San Joaquin Valley, and southern California. Parts of the project have been serving Californians since 1962.

The northernmost SWP facilities consist of three small lakes on Feather River tributaries in Plumas County, including Lake Davis, Frenchman Lake, and Antelope Lake. The branches and forks of the Feather River flow into Lake Oroville, the SWP's principal reservoir, with a capacity of 3.5 million acre-feet.

The North Bay Aqueduct, completed in 1988, supplies water to Napa and Solano Counties from the northern Delta. Near Byron in the south Delta, the Delta Pumping Plant lifts water into Bethany Reservoir. From this reservoir, some Delta water is lifted by the South Bay Pumping Plant into the South Bay Aqueduct, which serves Alameda and Santa Clara counties.

Most of the water flows from Bethany Reservoir into the California Aqueduct, which winds along the west side of the San Joaquin Valley into southern California.

Regional Water Projects

The American River Watershed is contained within Sacramento, El Dorado, and Placer Counties. Water supply demands within the watershed include agricultural, municipal, and industrial uses. The primary sources of water supply for the study area are ground water and surface water. Principal sources of surface water in the region are the American, Sacramento, and Cosumnes Rivers.

Communities above and adjacent to Folsom Reservoir, including Roseville, Auburn, Georgetown, Placerville, El Dorado Hills, Citrus Heights, Carmichael, Orangevale, and Fair Oaks, and areas downstream from Folsom Reservoir, including Rancho Cordova, Sacramento, Elk Grove, Galt, and Lodi, receive all or part of their municipal and industrial water supplies from the reservoir. Some agricultural demands originate in areas northwest of Folsom Reservoir. However, the major irrigation demands are in southeast Sacramento County. In western Placer County, there is potential for additional irrigation demands from Folsom Reservoir via diversion pipelines or from the upper American River via Auburn Ravine.

HYDROPOWER

The CVP hydropower system consists of eight powerplants and two pump-generating plants. This system is fully integrated into the Northern California Power System and provides a significant portion of the hydropower available for use in northern and central California. The installed power capacity of the system is 2,058 MW (megawatts). By comparison, the combined capacity of the 368 operational hydropower plants in California is 12,866 MW. The PG&E (Pacific Gas and Electric Company) is the area's major power supplier with a generating capacity from all sources of over 20,000 MW.

Power generated from the CVP system is dedicated first to meeting CVP project power requirements, primarily for pumping facilities. The remaining power is marketed by the Western Area Power Administration as commercial power with first preference to entities such as irrigation districts, municipalities, military installations, and Federal and State Government installations in California.

LAND USE AND SOCIOECONOMICS

This section describes the existing and projected future land use and related socioeconomy in the American River Watershed Project area that could be affected by the project. The focus of this discussion is on the lands in the American River flood plain and the lands in the upper American River area in and around the damsite near Auburn.

Flood Plain Area

The following sections profile the land use and related socioeconomic character of the urbanized portions of the American River flood plain and assess the prospects for continued development in the undeveloped portions of the flood plain. For purposes of this analysis, the study area is divided into three subareas: North Sacramento, South Sacramento, and Rancho Cordova. Data are provided on land use, population, employment, income, and public facilities and services. These data provide baseline information to conduct the socioeconomic impacts analyses presented in chapters 6 through 10.

Land Use

North Sacramento. The North Sacramento area covers approximately 6,000 acres in the flood plain north of the American River, south of Arcade Creek and west of the NEMDC. This highly urbanized area, which includes land of the Campus Commons subdivision and the Cal Expo facility, is protected from flooding by Folsom Dam and the north levee of the American River. The north levee of the American River runs from the mouth of the NEMDC to high ground near the Carmichael Bluffs. The predominant land use in this area is residential (4,760 acres). Commercial (445 acres), industrial (50 acres), and public (45 acres) land uses make up the balance of the development in the area. A small amount of agricultural/vacant land (600 acres) remains undeveloped. The total value of the

property subject to flood damage in the area was estimated to be $8.2 billion, of which 68 percent is residential, 28 percent commercial/industrial, and 4 percent public infrastructure.

South Sacramento. The South Sacramento area covers approximately 45,000 acres south of the American River. This area, more than half of which lies within the flood plain, is bounded by the Sacramento River on the west, the Beach Lake levee on the south, and Bradshaw Road on the east. Flood protection is provided by Folsom Dam, the south levee of the American River extending from the Mayhew Drain to the Sacramento River confluence, and the east levee of the Sacramento River from the confluence to the town of Freeport. The protected area contains downtown Sacramento, the State Capitol, CSUS, the Riverpark neighborhood, the Richards Boulevard area, and portions of the city's Land Park, Pocket, and Meadowview community plan areas. Within this area the predominant land use is residential (28,590 acres). Commercial (3,410 acres), industrial (505 acres), public (6,890 acres), and agricultural/vacant (5,605 acres) land uses make up the balance of South Sacramento. The total value of the structures subject to potential flood damage was estimated to be $23.4 billion, of which 69 percent is residential, 23 percent commercial/industrial, and 8 percent public infrastructure.

Rancho Cordova. The unincorporated Rancho Cordova area lies almost entirely within the flood plain south of the American River between Hazel Avenue and Bradshaw Road. This developing area is protected from flooding by Folsom Dam, the Sacramento County levee upstream from the Mayhew Drain, and high ground along the south side of the American River extending from the levee to Lake Natoma. The predominant land use in the area is residential (1,500 acres). Commercial (100 acres) and industrial (20 acres) uses make up the balance of the development in Rancho Cordova. Rancho Cordova also contains a substantial amount of open space south of Highway 50 (2,520 acres). The total value of the property subject to potential flood damage in the area was estimated to be $2.3 billion, of which 72 percent is residential, 21 percent is commercial/industrial, and 7 percent is public infrastructure.

City of Folsom. The City of Folsom covers approximately 16,000 acres and has a population of 39,850. It is bounded by Highway 50 on the south, Lake Natoma on the west, the Placer/Sacramento line on the north, and the El Dorado/Sacramento County line on the east. None of the incorporated city lies within the American River flood plain. Land uses within the city include residential (1,700 acres), commercial (179 acres), and industrial (152 acres). (City of Folsom, 1988.)

Population, Employment, and Income. The flood plain is occupied by about 400,000 people, who are distributed throughout the area. Natomas, one of Sacramento's fastest growing areas in the 1980's, accounts for 35,000 residents, most of whom live in the South Natomas community plan area. The Dry Creek area is sparsely populated due to its relatively large lot sizes and contains only 2,500 residents. North Sacramento with 55,000 residents and South Sacramento with 290,000 contain the bulk of the study area population. Rancho Cordova with 17,500 residents accounts for the balance. Based on a

city-wide average of 2.5 persons per household, it is estimated that flood plain residents occupy approximately 180,000 housing units in the area as a whole. Average housing costs range from $89,400 per home in North Sacramento to $89,000 in Natomas, $83,300 in South Sacramento, and $111,700 in Rancho Cordova. Flood plain residents are part of the labor force employed in the Sacramento Metropolitan Statistical Area comprising El Dorado, Placer, Sacramento, and Yolo Counties. The service industry, retail trade, and government provide nearly two-thirds of all the jobs in this diverse labor market; the average annual income for the City of Sacramento is $15,265. (Hornor, 1994.)

Public Facilities and Services

Water Supply. The City of Sacramento obtains its water supply from both surface- and ground-water sources. The city has water rights to both the American and Sacramento Rivers under a perpetual contract with Reclamation (City of Sacramento, 1988). In 1987, the City of Sacramento used about 33 percent of its total water rights. Thirty public and privately owned water purveyors supply water for areas outside the city limits. Residential users within the City of Sacramento consume 8,000 gallons per acre per day. Per capita residential water use is estimated at 0.19 acre-feet annually (Boyle Engineering, 1989). The daily consumption of water is about 4,000 gallons per acre for commercial users and about 1,700 gallons per acre for industrial users.

Sewage System. The City of Sacramento and Sacramento County are served by the Sacramento Regional County Sanitation District. District facilities in North Natomas were constructed to serve South Natomas and adjacent areas. Flows for the Sacramento area average 400 gallons per day for single-family dwelling units, 300 gallons per day for multifamily units, and 2,625 gallons per day for commercial/industrial property.

Solid Waste. Prior to 1992, the City of Sacramento collected and transported all residential solid waste to the landfill site at 28th Street and A Street. However, the capacity of this site has been exhausted, and the city is currently using the county landfill site on Kiefer Boulevard, which is expected to be at capacity by approximately 2005. Each Sacramento resident disposes of approximately 4.26 pounds of solid waste per day, and commercial/industrial land users dispose of about 1 pound of solid waste per 100 square feet per day.

Emergency Services. The Sacramento City Police Department provides protection for most of the urbanized portion of the project area. The Police Department currently has a ratio of 1.7 police officers (uniformed and civilian) per 1,000 persons. The unincorporated North Natomas area is under the jurisdiction of the Sacramento County Sheriff's Department. The Sutter County Sheriff's Department provides protection for south Sutter County.

Upper American River Area

The upper American River area encompasses portions of Placer and El Dorado Counties and includes the lands within and immediately around the damsite near Auburn ("canyon area") and the lands occupied by the surrounding communities.

Land Use. The canyon area consists of about 42,000 acres of land ranging from gently sloping to extremely steep land in the canyons along the Middle and North Forks of the American River and includes the site of the Reclamation's authorized multipurpose Auburn Dam. Most of the property within the canyon area (26,100 acres) is owned by the Bureau of Reclamation. These lands are managed by the California Department of Parks and Recreation as part of the Auburn State Recreation Area under a contract with Reclamation. Recreational use of these lands is restricted by terrain, lack of offroad parking, and road access to river facilities. Despite these limitations, the Department of Parks and Recreation estimates informal recreational use within the Auburn State Recreation Area at 550,000 visitor days annually. The canyon area supports a system of trails which are used for recreation. Scheduled events include the Tevis Cup (endurance horse ride) and the Western States Endurance Run (foot race). Most activity is within the river and on the river bars. Limited portions of the canyon area (about 11,000 acres) are under the ownership of the Bureau of Land Management or U.S. Forest Service. The remainder of the area (about 5,000 acres) consists of isolated, privately owned parcels.

The communities surrounding the canyon area, including Auburn, Cool-Pilot Hill, Greenwood, Garden Valley, Georgetown, and Lotus-Coloma, have generally experienced growth significantly higher than statewide averages. The primary stimuli for this growth have been the attraction of rural and scenic settings, recreational and scenic attributes, mild climate, availability and price of homesites, and relative proximity to major employment centers. Major constraints to growth vary by subarea and include water supply and conveyance limitations, sewage service and septic tank suitability, lack of access and transportation capacity, slope and soil conditions, and zoning restrictions. Higher intensity urban uses are concentrated primarily in the Auburn area. The predominant land uses within the remainder of the study area are low-density residential, rural residential parcels (improved and unimproved), forest and recreation, open space and conservation, and nonintensive agriculture and grazing land.

Growth. Growth rates for the communities within the upper American River area are expected to be higher than the State average over the next 15 years based on California Department of Finance projections, Department of Water Resources 1989 projections for western El Dorado County, and information from county planning staffs and regional planning organizations. Projected population for 2010 is 79,252. Buildout population under current area plans is estimated at 114,056.

Population. Only Auburn is expected to reach buildout under current plans by the year 2010. Based on projected population rates, none of the El Dorado County subareas would reach buildout by 2010. In areas such as Cool-Pilot Hill and Georgetown, where

buildout populations greatly exceed current population, buildout can be expected relatively far in the future. Auburn, with 73 percent of the total population, would continue as the largest urban center. However, the El Dorado County subareas are expected to experience significantly higher rates of growth than the Auburn area; Cool-Pilot Hill and Georgetown are expected to be major population centers.

Housing. The demand for additional housing to accommodate future population growth is likely to be substantial. As there is limited housing development in the El Dorado County subareas, the impacts would be greatest in these plan areas. A total of 31,700 housing units are anticipated within the overall plan area by 2010. Based on current area plans, there would be an estimated 50,291 housing units at buildout. Auburn would continue to have the greatest concentration and mix of housing. In El Dorado County, the largest concentration would be in Cool-Pilot Hill, which also would have the largest increase in medium and high density units. Medium density development is also included in the plans for Garden Valley and Georgetown and to a lesser degree in Lotus-Coloma.

Water Supply. The population of California is expected to increase by about 75 percent, or to nearly 60 million, by the year 2020. Much of this increase will be in the central and northern portion of the state. In the five-county area of El Dorado, Placer, Sacramento, San Joaquin, and Sutter, this increase is expected to be significantly greater. The current population of about 2 million in this area is projected to increase to about 3.8 million by 2020, or by nearly 95 percent.

The additional population will place demands on existing water supplies (see table 4-1), especially for M&I (municipal and industrial) uses. The 1990 agricultural and M&I water demands in the five-county area was about 2.7 million acre-feet per year. By 2020 this demand is expected to increase by about 300,000 acre-feet per year to approximately 3 million acre-feet per year. There will be a reduction in demands for agricultural uses by about 250,000 acre-feet per year due to water conservation measures, marginal lands ceasing production, or some lands being converted to urban uses. Demands for M&I uses, however, are expected to increase by over 0.5 million acre-feet per year, even accounting for water conservation measures.

As today, future water supplies will be provided from a combination of surface and ground-water sources. A breakdown of these relative supplies is shown in table 4-1. It is expected that the total future supplies will equal about 2.5 million acre-feet.

Future demands less future supplies are a measure of potential unmet water needs. The estimate future (2020) unmet needs will amount of over 500 acre-feet per year in the five-county area. This growing need for additional supplies will not be met throughout the CVP and SWP (State Water Project) system service areas. Accordingly, any decrease in the capability of the system to deliver water supplies will add to the expected future net demands for water.

Sewage System. Sewage treatment plant facilities and sewage lines would have to be expanded in all the subareas to serve projected population growth. The buildout under the current Auburn plan would require expanding the existing treatment plants. This is anticipated under ongoing planning by the servicing districts. Higher density development, anticipated in all the subareas, would require public sewer service, which does not currently exist. A major expansion program would be required in the Georgetown Divide Public Utility District, which would service all but the Lotus-Coloma area. The El Dorado Irrigation District would service Lotus-Coloma.

Solid Waste. Solid waste generated by the projected buildout population in the Auburn Plan Area could be accommodated by existing and planned landfill capacity and recycling programs. The solid waste generated in the El Dorado County subareas in

TABLE 4-1

American River Watershed and Vicinity - Water Needs (2020)
(1,000 acre-feet per year)

County	Water Demands						2020 Supply			Unmet Need
	1990			2020						
	Agricultural	M&I[1]	Total	Changes Agricultural	Increase M&I	Total	Surface Water	Ground Water	Total	
El Dorado	19.2	26.9	46.1	0.8	38.4	85.3	48.2	0	48.2	37.1
Placer	245.9	99.3	345.2	-17.7	65.4	392.9	190.4	124.6	315.0	77.9
Sacramento	361.5	390.1	751.6	-79.9	305.5	977.2	326.7	476.0	802.7	174.5
San Joaquin	1120.7	111.3	1232.0	-109.5	125.6	1248.1	500.6	617.9	1118.5	129.6
Sutter	307.8	0.9	308.7	-54.5	26.1	280.3	124.7	119.6	244.3	36.0
Delta Salinity[1]			70.0			70.0			0	70.0
Total	2055.1	628.5	2753.6	-260.8	561.0	3053.8	1190.6	1338.1	2528.7	525.1

[1] M&I = municipal and industrial.
Source: U.S. Bureau of Reclamation, American River Water Resources Investigation, Spring 1995.

combination with other waste generated in the county would require a new landfill site or significant expansion of the existing site by 2000 and other methods to reduce waste volumes.

Emergency Services. Demand for medical services would increase due to the population growth. The City of Auburn renovated a building to house fire and police departments. The major expansion requirement would be increased personnel. The Placer County Sheriff's office would require a significant increase in personnel and presumably facilities including jail expansion.

RECREATION

This section summarizes the recreation resources and opportunities in the study area. The SAFCA Interim Reoperation of Folsom Dam and Reservoir report (December 1994) and Jones & Stokes Associates Folsom Dam and Reservoir Permanent Reoperation Study Supplemental Report (May 1995) were used to prepare this section.

Lower American River. The American River Parkway includes a series of 14 parks distributed on publicly owned lands along the lower American River. Earthen levees as much as 20 to 30 feet high border much of the lower half of the parkway and block out surrounding urban development and activity. These physical barriers and extensive stands of mature riparian forest give the parkway a "wilderness in the city" quality.

The Jedediah Smith Trail provides bicycle, pedestrian, and equestrian trails from Discovery Park to Folsom Reservoir and is one of the parkway's most popular features. The trail also connects with the Sacramento River Trail and Old Sacramento State Historic Park. The 23 miles of river below Nimbus Dam is included in both the State and Federal wild and scenic river systems. Entrance fees are charged for all automobile access roads during peak-use seasons from late spring to early fall.

Managed by Sacramento County Parks and Recreation Department, the parkway is recognized as one of the Nation's premier urban parkways, providing outstanding recreation for the 750,000 people who live within a 30-minute commute. Estimated parkway use in 1988 was 5.5 million visitors. That figure is expected to grow to 7.5 million by 2000 and to 9.6 million by 2020 (Hinton, 1987). A 1983 Sacramento County survey revealed that 32 percent of these visits were associated with water-dependent activities (swimming, boating, and fishing) and 53 percent were associated with water-enhanced activities such as jogging, nature study, hiking, and picnicking.

The lower American River is a major site for recreational boating, including rafting, kayaking, and canoeing, and accounts for about 662,000 user-days annually, or 12 percent of the total recreation for that area (SWRCB, 1988). Seasonal temperatures and riverflows affect commercial rafting. When ambient temperatures are cold, rafting declines, even during the peak recreation season. About 90 percent of the annual rental business occurs between Memorial and Labor Days, although prime conditions may exist into October (David Hill, pers. comm., 1989).

Swimming and wading are other popular water-dependent activities affected by riverflows. These activities account for about 10 percent of the total recreation in the parkway, or about 552,000 annual visits. Of the 10 popular swimming areas, only Paradise Beach and Tiscornia Park have beaches with extensive areas of sand.

Folsom Reservoir

For purposes of evaluating the recreational resources, the Folsom Reservoir area includes Folsom Lake and Lake Natoma.

Folsom Reservoir. Folsom Lake State Recreation Area is one of the most heavily used units in the California park system. Proximity to a major metropolitan area, arid summer climate, high regional interest in recreation, and diminishing open space and recreation resources make the lake a significant regional and State recreation resource. Activities include sailing, water and jet skiing, and wind surfing. The lake's upper arms are designated slow zones for quiet cruising, fishing, and nature appreciation. Brown's Ravine Marina provides 670 berthing slips for year-round mooring (depending on lake levels) and small craft rentals and supplies. Recent dredging of the marina for fill material for the Mormon Island Dam repairs should allow longer periods of use at the marina for both moored and launched boats.

The lake has up to 75 miles of undeveloped shoreline providing quality swimming beaches, some with lifeguard services. Summer water temperature averages 72 °F, enhancing both water-oriented and shoreline activities. An area with important scenic, natural, and cultural values surrounds Folsom Lake and provides opportunities for camping, picnicking, hiking, and nature study. About 180 miles of unpaved roads and trails are available for hiking and horseback riding, in addition to the 8.4-mile paved bike trail connecting with the parkway's Jedediah Smith Trail.

According to the Department of Parks and Recreation, the optimal lake elevation for recreation use is 436 feet, which makes all facilities available and allows the beaches to accommodate high use levels. Approximately 9,600 surface acres are available at this elevation. Lake elevations higher than this reduce the carrying capacity of the lake as some boat ramps and parking spaces are eliminated. Most of the boat ramps are unusable about elevation 420 (8,500 surface acres); by elevation 405 (7,300 surface acres), only one boat ramp is still usable for launching.

Changes in water-surface elevations from May through August will have greater effects on use patterns. In winter, use patterns exhibit a greater degree of flexibility relative to water-surface elevations. One hundred percent of potential use is never realized because of displacement; that is, as conditions become ideal for one recreational activity, they deteriorate for another. For example, with increased water and jet skiing, windsurfing and sailing conditions deteriorate because of wake disturbances.

Currently, about 2.1 million recreation users visit Folsom Lake annually. About 95 percent of the day-users and one-third of the campers come from the Central Valley, one-third from the San Francisco Bay Area, and the remaining one-third from elsewhere. Visitation data collected from 1976 through 1987 by the Department of Parks and Recreation show 141,000 as the average monthly visitation to Folsom Lake. Visitation peaks in

summer. The lowest use period was in December 1982 (7,224 visits), and the highest use month was 502,187 in June 1985.

Lake Natoma. Formed by Nimbus Dam, Lake Natoma is the downstream end of the Folsom Lake State Recreation Area and serves as a reregulating reservoir for the varying water releases from Folsom Dam. Because there are only slight variants in water fluctuation, the lake has developed an attractive, natural-appearing band of riparian vegetation around its shores.

Lake Natoma is managed by the Department of Parks and Recreation as a passive recreation area; the emphasis is on nonmotorized water recreation. Developed facilities include the aquatic center for California State University at Sacramento, a picnic area, and an 8.4-mile segment of the American River paved bicycle and pedestrian trail, which continues to Folsom Reservoir.

Bank fishing is common at the lake, and people swim and dive at the rock outcrops at the lake's upper end. Since water temperatures during the summer are cooler here than at Folsom Reservoir upstream, the lake is less heavily used for swimming and wading.

Upper American River

Reclamation contracted with the Department of Parks and Recreation to provide recreation and public-use management services on the lands within the boundaries of the multipurpose Auburn Dam project, known as the Auburn State Recreation Area. This area includes 42,000 acres and extends upstream on the North Fork American River to Iowa Hill bridge and upstream on the Middle Fork to Oxbow Reservoir.

Rushing rapids, punctuated by deep clear pools within steep canyons, surrounded by wooded ridgelines, articulate the essence of the American River through this area. This juxtaposition of rugged terrain and free-flowing water creates a dynamic setting for a diversity of unique recreation opportunities from whitewater boating to recreational gold mining and picnicking.

Its proximity to major population centers and diverse recreation base make the Auburn State Recreation Area one of the most used and significant recreation resources in northern California. The expected growth of the surrounding Mother Lode and Sacramento metropolitan areas will make this resource more important for future generations. The recreation area is especially accessible to the surrounding population because of its location near major transportation corridors. Interstate 80 lies along the northwest margin of the area and brings it within a 2-hour drive from much of the San Francisco Bay area, and even less from Reno. Highway 49 traverses the Auburn State Recreation Area from the north and south.

Local interest in outdoor recreation is intense. Bicycling (road and mountain biking) has increased dramatically in the area. There is continuing demand for equestrian trails and

other trails. Indications are that there will be a continued increase in demand and a continued deficit in resources to meet this demand regionally.

The Tevis Cup (endurance horse ride) and the Western States Endurance Run (foot race), both 1-day, 100-mile events using the Western States Trail, draw entrants from all over the world. Approximately 72 miles of hiking trails, 66 miles of equestrian trails, and 15 miles of fire road are open to mountain bikes in the Auburn State Recreation Area and provide year-round recreation opportunities. These trails and roads include Manzanita Trail, Middle Road Trail, Pointed Rock Trail, Old Quarry Road Trail, Tinkers Cutoff, Old Stage Road, Old Auburn-Foresthill Road, a number of other trails, and many mountain bike trails. Additionally, the Western States Trail has been included as the trans-Sierra route of the proposed coast-to-coast American Discovery National Trail.

The Department of Parks and Recreation has the responsibility for maintaining these trails; due to budget constraints, the only maintenance is accomplished by volunteer workers, usually associated with the Western States Endurance Run.

Whitewater boating on the Middle and North Forks of the American River is of State and national significance. Both forks offer overnight camping, hiking trails, cultural and natural observation sites, and a diversity of difficulty in whitewater rapids from beginning to advanced boating skill levels. The nearby South Fork of the American River offers a less challenging whitewater experience, and because of the predominance of private lands and development along the river corridor, camping is restricted. The nearest similar "wilderness" whitewater river, providing overnight trips, is the Tuolumne River, about 100 miles southeast of the recreation area.

Also of significance is the scenic value of the upper American River. Many tributary streams flow into the forks of the American at a very high gradient, creating small cascades and waterfalls. The major rapids on the main stems of the North and Middle Forks provide unique scenic features in a setting with few visible human intrusions. The North Fork of the American remains one of the last free-flowing rivers in California. Equally significant is the concentration of historic sites and remains in the canyons, especially along the Middle Fork.

Although other recreation areas such as the lower American River Parkway are more heavily visited regionally (5 million), the Auburn State Recreation Area (550,000) is still an important recreation resource for the Sacramento metropolitan area. Since it is within a 20- to 50-minute drive for most area residents, the area provides a quick afternoon escape. The cool waters of the area offer a compelling respite when temperatures in the Sacramento area exceed 100 °F. This increase in visitation adds to parking congestion at the confluence on summer weekends. The most popular month for the recreation area is July, when about 20 percent of annual visitation occurs. Some 46 percent of the annual use is between June and August, and use tapers off in the fall and winter.

Upper Sacramento River

The principal recreational resources in the upper Sacramento River area are Shasta and Clair Engle Reservoirs. These facilities are administered by the U.S. Forest Service as National Recreation Areas. These National Recreation areas were established by Congress in 1965 and encompass a total area of 203,500 acres (U.S. Department of Agriculture, 1987). Fishing, boating, and sightseeing are popular recreational uses of these two reservoirs.

Facilities at Shasta Reservoir include boat ramps, 22 developed campsites (21 of which accommodate camp trailers and recreational vehicles), and 4 day-use picnic areas. Clair Engle Reservoir has 21 private and/or government-managed campgrounds, 4 day-use picnic areas, 5 resorts or marinas, and 11 boat ramps. During low lake levels, boat launching is available at only one or two of the marinas. Low lake levels during the recent drought caused a decline in the recreational use of Clair Engle Reservoir. This decline prompted the U.S. Forest Service to restore some of the more popular campgrounds (Arnold, USFS, pers. comm.). Popular forms of recreation include jet skiing, sailing, waterskiing, canoeing, swimming, camping, picnicking, and hiking (Reclamation, 1991).

No campgrounds are established on Keswick Reservoir. Recreational use of the lake is predominantly for fishing. Keswick Reservoir has one boat launching facility.

AFFECTED NATURAL ENVIRONMENT

FISHERIES

Fishery habitats evaluated include the lower American River, Folsom Reservoir, and upper American River areas and the upper and lower Sacramento River areas.

The aquatic environment and the fish fauna in the lower American River have been significantly altered from historic conditions. Several factors have contributed to this alteration of the lower American River, including the construction of Folsom and Nimbus Dams (in 1955), regulation of riverflows, and the introduction of nonnative fish species. The American River historically provided over 125 miles of riverine habitat to anadromous and resident fish species (Gerstung, 1971). Only the 23 miles from Nimbus Dam to the mouth of the lower American River remain as available habitat to anadromous fish species.

The lower 23 miles of the river, including backwaters and dredge ponds, supports at least 41 fish species, half of which are game fish (FWS, 1991). Common species include chinook salmon, steelhead trout, American shad, rainbow trout, striped bass, black bass, carp, Sacramento squawfish, Sacramento suckers, and hardhead. Recreation and commercial values make the fall-run chinook salmon the most important species in the lower river. The schedule of reservoir releases during spring and summer can cause temperatures in the lower

river to reach marginal to lethal thresholds, forcing these anadromous species to areas near Nimbus Dam, where they face increased predation and competition (FWS, 1991).

Because of the lack of access to the natural spawning areas in the headwaters of the American River and the lack of cold water during spring and summer, natural production of steelhead in the lower American is negligible. Artificial production of anadromous species at the Nimbus Hatchery maintains the population. Striped bass and American shad are also important species. The other fish species inhabiting the lower river are generally considered of secondary importance because their value as commercial and sport fisheries is minor (FWS, 1990).

Flows in the lower American River are controlled by the coordinated operation of Folsom and Nimbus dams. Generally, these flows differ considerably from flows under historic (predam) conditions, when flows were generally higher from February through June and lower from early July to February (Rich and Leidy, 1985). Water temperature regimes also have been influenced by the operation of Folsom and Nimbus Dams.

In 1958, the SWRCB (California State Water Resources Control Board) issued Decision 893 (D-893), which established minimum flow releases in the river of 250 to 500 cfs. Since that time, public attention to and use of the river's fishery have increased, and there is concern that D-893 flows will not sustain the recreation and fishery activities that have developed in the lower river over the past 30 years. The instream flows required to protect the salmon and steelhead trout populations have been the subject of much public debate and governmental attention. In 1973, decision 1400, issued by the State Water Resources Board, proposed an increased flow regime of 800 to 1,250 cfs in anticipation of the construction of the large multipurpose Auburn Dam, which was never completed. Although Reclamation is legally required only to maintain D-893 flows, it currently operates Folsom Dam at a level to meet the D-1400 requirement when there is sufficient water in the system.

Flows in the lower American River undergo substantial fluctuations in response to CVP and SWP obligations to maintain SWRCB-mandated water-quality and flow requirements in the Delta. When insufficient water is available in the Delta to maintain SWRCB requirements, the CVP and SWP first curtail total water exports from their two pumping facilities in the Delta. If that action is inadequate to achieve SWRCB flow requirements, water releases are increased from upstream reservoirs operated by the CVP and SWP. Released water takes about 12 hours to reach the Delta from Folsom Dam, about 2 days from Oroville Dam, and about 5 days from Keswick Dam. Because of the proximity of Folsom Dam to the Delta and the relatively short time period required for water to travel to the Delta, releases from Folsom Dam are often relied on to meet SWRCB Delta flow requirements. This reliance on releases from Folsom Dam oftentimes results in rapid fluctuations in flow levels in the lower American River.

In general, flow fluctuations in the lower American River are most frequent and of greatest magnitude during spring and summer, although "step" increases and decreases do

occur during fall. Spring and summer flow fluctuations can be considerable. For example, a flow increase from a mean daily flow of 329 cfs on June 1, 1990, to 7,500 cfs on July 11, 1990, was accompanied by a water-surface elevation change of several feet (McEwan, 1991). Although this specific example illustrates a relatively large change in flow over a period extending about 6 weeks, flow fluctuations of lesser magnitude over the same duration are frequent. Presently, the fishery resources of the lower American River are subjected to relatively rapid and erratic flow fluctuations of variable magnitude.

The primary species of management concern and economically most important fishes in the lower American River are the four anadromous species, including chinook salmon, steelhead trout, striped bass, and American shad. The most popular sport fisheries in the lower American River are for chinook salmon during fall, steelhead trout during winter, American shad during late spring, and striped bass during late spring and summer.

Over one-half of all fish species known to occur in the lower American River are nongame fishes. The most abundant species of nongame fishes in the river include Sacramento sucker, Sacramento squawfish, tule perch, and riffle sculpin. Although each species, including nongame species in the lower American River, fulfills an ecological role, the evaluation of potential project impacts and alternatives is focused upon chinook salmon and steelhead trout. These species are considered to be the primary species of management concern because of their economic and recreational value.

Recent studies of habitat availability, fish abundance and distribution, physiology, emigration, and several other aspects of fishery resources in the lower American River have been and are being conducted by the Fish and Wildlife Service; DFG (California Department of Fish and Game); Sacramento County, East Bay Municipal Utility District; the University of California at Davis; and California State University, Sacramento. The intent of those studies has been to reduce the uncertainty regarding habitat requirements of aquatic public trust resources of the lower American River, emphasizing fall-run chinook salmon. The following information incorporates preliminary findings from these studies and from previous work.

Folsom Reservoir

The Folsom Reservoir Area includes Folsom Reservoir, Lake Natoma, and the Nimbus Salmon and Steelhead Hatchery. This subsection describes the aquatic habitat and fisheries in this area potentially affected by the project.

Folsom Reservoir. Folsom Reservoir supports both cold and warmwater fisheries. However, Folsom's productivity is low because of low levels of nutrients and annual fluctuations in the reservoir water surface. The Department of Fish and Game maintains the existing coldwater fishery, consisting of previously planted, land-locked populations of salmon and ongoing hatchery plantings of rainbow trout. Natural production does occur in streams leading to the lake, but is limited by instream factors such as barriers and fluctuating flows. The reservoir supports many resident nongame fish and warmwater game fish,

including large and smallmouth bass, white catfish, brown bullhead, channel catfish, and several sunfishes.

Inundation of the area upon closing of Folsom Dam (constructed in 1955) transformed this previously free-flowing section of the river into a lentic (slow-moving or still waters) aquatic environment (the reservoir). The mean and maximum Folsom Reservoir depths are 66 and 266 feet, respectively. A thermocline develops in the reservoir each year with adequate oxygen for fish in the hypolimnion. No chronic water-quality problems have been identified. Average total dissolved solids and total phosphorus levels in the period from 1970 to 1979 of 46 milligrams per liter and 0.02 milligrams per liter indicate low nutrient levels. This contributes to Folsom Reservoir's lower productivity as compared to many other Central Valley reservoirs.

Folsom Reservoir and other reservoirs in the CVP system are managed for multiple uses, with water supply and flood control being the two principal uses. Optimum or even self-sustaining populations of game fish in reservoirs often are not achieved simultaneously with water supply and flood control management. Such conflicts typically restrict the productivity of reservoir fish populations (Summerfelt, 1993).

Folsom Reservoir is usually subject to substantial reductions in water-surface elevation from late spring and summer until inflow increases during the winter rainy season, primarily during the spring snowmelt runoff period. Fluctuation in water-surface elevation influences fish habitat in reservoirs. For example, fish that spawn on reservoir slopes risk having eggs dewatered or placed at a depth too deep for egg development (Moyle et al., 1989).

Current operation of Folsom Reservoir is believed to adversely affect both spawning and juvenile survival of many resident warmwater fish species, primarily from fluctuations in surface elevation during nesting periods, resulting in either nest flooding or dewatering. The result has been relatively low annual production of centrarchids (bass, sunfish, and crappie) and ictalurids (bullhead and catfish). Consequently, Folsom Reservoir's centrarchid and ictalurid fisheries are marginal compared to those found in similar natural lakes that do not undergo reservoir operations.

Rainbow trout in Folsom Reservoir are not closely associated with littoral habitats; their habitat consists of the coldwater pool (waters below 65 °F). This is restricted to the hypolimnion during periods of thermal stratification, but constitutes the entire reservoir in late fall through spring. Salmonid spawning is not believed to be successful in Folsom Reservoir. Trout populations are maintained by stocking.

<u>Lake Natoma</u>. Lake Natoma was constructed as a regulating afterbay for Folsom Reservoir power generation flow releases. As a consequence, water-surface elevation in the reservoir can fluctuate daily and weekly from 4 to 7 feet (FWS, 1990a).

As a regulating afterbay, variable water temperatures and rapid water turnover (that is, flushing rates) result in a relatively inhospitable environment for fisheries. Lake Natoma supports essentially the same fish species as are found in Folsom Reservoir, but at much reduced levels. Water-level fluctuations, cold temperatures, and limited food production result in few fish. The Department of Fish and Game now plants some 1,000 one-half-pound catchables on an annual "free fish day." The Nimbus Salmon and Steelhead Hatchery is immediately downstream from Nimbus Dam.

Nimbus Salmon and Steelhead Hatchery. The Nimbus Salmon and Steelhead Hatchery, located downstream from Nimbus Dam, is operated by the Department of Fish and Game under contract with the Federal Government. The hatchery was built by the Federal Government in the late 1950's as a compensation feature of the Folsom Dam project. Originally, the hatchery was planned to incubate 30 million chinook salmon and steelhead trout eggs and to rear the fry to a size suitable for release in the American River. However, subsequent management decisions changed the operation, and the objective of the current program is to take fewer eggs and raise fewer but larger fish, including 3 million smolt-size (60 fish/lb) fall-run chinook salmon and 300,000 yearling (10 fish/lb) steelhead trout for release in the estuary (FWS, 1990a).

The incubation survival rates of eggs are critically dependent on water temperature in the hatchery as well as in the river. Healey (1979) reported egg mortalities of 80 percent at water temperatures of 61 °F and 100 percent at 63 °F for Sacramento River chinook salmon. Egg incubation survival is highest at water temperatures at or below 56°F. The temperature of the water released from Nimbus Dam into the hatchery often exceeds this level during the early part of the fall-run chinook salmon spawning and incubation period, resulting in significant losses of eggs. In recent years, egg taking operations have been delayed as late as the latter part of November.

Juvenile chinook salmon in the lower American River experience chronic temperature stress, which is a primary concern during the peak rearing period from April through June. Hatchery production is generally less affected than in-river production by the existing unsuitable spring temperature regime of the river, because the hatchery reared smolts and yearlings are transported and released directly into the Delta. Also, hatchery-produced fry are usually released before March or April. Nonetheless, spring water temperatures frequently exceed suitable levels for juvenile chinook salmon in the hatchery. Water temperatures suitable for rearing may be achieved during spring by increasing discharge from Folsom and Nimbus Dams. However, dependent upon inflow and release patterns, cold water used during the spring reduces the availability of cold water during chinook salmon spawning in fall, with the result delayed egg take or increased egg mortality or both.

A significant steelhead trout sport fishery, generally believed to be supported almost entirely by hatchery production, exists in the lower American River. Eggs are generally taken at the hatchery from January through March. Water temperatures during the summer and early fall in the hatchery often exceed suitable levels for rearing juvenile steelhead trout,

and rearing juveniles are transported to rearing facilities at the hatcheries on the Feather and Mokelumne Rivers.

Upper American River

Steep rocky canyons characterize the upper reaches of the North and Middle Forks of the American River, whereas the lower reaches contain long and wide riffles and pools. Historical documentation is limited regarding fisheries in the area. Today, year-round residents of the North Fork include several warmwater species, among them smallmouth bass, bullhead, and sunfish. Many pools and riffles with gravels suitable for trout and smallmouth bass exist in the river. But low summer flows and high water temperatures greatly reduce the use of this habitat by coldwater species. Surveys by the FWS on September 20 to 28, 1989, found 38 fish, including warmwater species such as smallmouth bass, riffle sculpin, Sacramento sucker, Sacramento squawfish, and brown bullhead, while trout were scarce. Lake Clementine contains a similar species composition; however, the Department of Fish and Game periodically plants trout.

Historical records of fish resources in the Middle Fork are limited. In the past, rainbow and brown trout have been stocked.

Construction of the Middle Fork American River project by Placer County Water Agency resulted in cooler water temperatures in summer and fall and improved habitat suitability for resident and stocked coldwater species, including rainbow and brown trout. FWS surveys in the Middle Fork, September 20 to 28, 1989, recorded 51 fish, including Sacramento hitch, Sacramento sucker, Sacramento squawfish, riffle sculpin, and brown and rainbow trout.

During May and September 1989 FWS biologists surveyed the North and Middle Forks of the American River to observe the aquatic habitat and to determine the types and relative abundance of resident fish. The North Fork supports a variety of warmwater species including smallmouth bass, bullhead and sunfish, on a year-round basis. Although a few trout are present, summer/fall water temperatures are generally too warm for suitable summer rearing. Ongoing instream mining operations and the results of earlier construction at the Auburn Dam site are the most apparent disturbances along the river. The Middle Fork American River, in contrast, supports both warmwater and coldwater species year-round. Cooler temperatures resulting from the Middle Fork American River Project support brown and rainbow trout for about 10 miles below the dam. Habitat is more suitable for warmwater species below this point.

North Fork. Below the Colfax-Iowa Hill Bridge, the North Fork flows through steep-sided canyons with 30-60 percent or greater slopes. Riffles are generally small in area and interspersed between series of deep pools and cascades. All 25 miles surveyed by FWS contain suitable rearing habitat for resident fish. However, low summer flows and high water temperatures reduce habitat suitability for coldwater species.

A total of 58 riffles and 64 pools occur from the Colfax-Iowa Hill Bridge downstream 25 miles to the Auburn Dam site . Forty-three of the fifty-eight riffle areas (77 percent) are in an 8 mile stretch between Shirttail Creek and Lake Clementine. The average riffle is 196 feet long, 82 feet wide and 4 feet deep. The average pool is 246-foot-long, 77-foot-wide and 14-foot deep. The majority of these riffles had significant areas with a combination of gravels from 0.25 to 3.0 inch diameter and underlying cobbles suitable for trout and small mouth bass spawning (Reiser and Bjornn, 1979; FWS 1983, 1984). Sediments covered less than 25 percent of these gravel areas (FWS 1991).

Historical background on fish resources of the North Fork is limited. California Department of Fish and Game records of stream surveys from 1934-1938 prior to Folsom Dam construction indicated that a variety of warm and coldwater species were observed. Post-Folsom Dam surveys in 1965 also included smallmouth bass (Micropterus doloieui) in addition to those found in the 1930's, and densities of approximately 100 trout per mile were observed (FWS 1991).

Lake Clementine begins about 3.5 miles above the Auburn Dam site and extends 5 miles upstream. Similar fish species occur in the North Fork and in Lake Clementine. The Department of Fish and Game periodically stocks rainbow trout in Lake Clementine. The most recent records for angler use estimate about 5,000 angler-days annually are spent on Lake Clementine (Kennedy Engineers, 1971). Access to lower Lake Clementine is limited due to parking and boat launching space constraints (FWS 1991).

Below Lake Clementine, there are fewer riffles and increased sediment deposition is evident. Below the Middle fork confluence, gravel sizes decrease and sand bar deposits increase. The three-fourth mile stretch of channel above the Bureau's coffer dam site is covered by sand deposits which accumulated during operation of the coffer dam (FWS 1991).

Throughout the reach from Colfax-Iowa Hill to Auburn Dam site, fringes of riparian vegetation overhang the channel. Willow, alder and blackberry are predominant. Large gravel bars are also sparsely vegetated with these species. The steep canyons and narrow channel likely have a much greater influence on water temperature than the overhanging vegetation. Daily incidence of direct sunlight exposure on the river is greatly reduced by the steep and closely adjoining canyon walls (FWS 1991).

Disturbance of the substrate is evident along most of the river channel, due apparently to numerous instream mining operations. Tailing piles and diversions are common. Surveys (FWS 1989) indicate that low flows and high temperature in the summer favor greater abundance of warmwater species. Smallmouth bass, riffle sculpin, Sacramento sucker, Sacramento squawfish and brown bullhead were found in significant numbers in pools and riffles, whereas trout were scarce. A fish sampling survey conducted by FWS along the North Fork American River between September 20-28, 1989 identified 25 smallmouth bass, 2 Sacramento squawfish, 3 riffle sculpin, 3 Sacramento sucker, 3 brown bullhead, 3 green sunfish, and 1 rainbow trout (FWS 1991).

Sport fishing is concentrated at the major access points along the river (e.g., at the Colfax-Iowa Hill Bridge, Yankee Jim bridge, Ponderosa Bridge and other vehicle access roads) (FWS 1991).

Middle Fork. From Oxbow Reservoir/Ralston Afterbay downstream to the confluence, the Middle Fork flows through steep-sided canyons of 30 percent or greater slopes. Riparian vegetation comprised of willows, alder, blackberry and some cottonwood overhangs the channel in many places. Similar to the North Fork, the steep canyon walls and narrow stream channel likely influence water temperature more than the overhanging vegetation. Construction of the Placer County water Agency's Middle Fork American River project in 1962, above and including Oxbow Reservoir, provided much cooler water temperatures during the summer and fall, thereby improving habitat suitability for resident coldwater species (FWS 1991).

Overall, 66 riffles and 67 pools occur in this segment of the Middle Fork. The average riffle is 132-foot-long, 106-foot-wide and 6-foot-deep. Riffle areas in the uppermost portion (upper 3 miles) above Kanaka Rapids generally contained cobbles and boulders (10-160 inches diameter) unsuitable for trout and smallmouth bass spawning. Below Kanaka rapids, wide beds of gravel of 0.25 to 3.0 inches in diameter and larger, with less than 25 percent fines covering the surface, were common. There are also numerous smaller gravel areas in shallow pools, along channel margins and on inside bends. Suitable spawning habitat for trout and smallmouth bass is present from below Kanaka Rapids to the confluence (FWS 1991).

Evidence of gold dredging activity and substrate disturbance (tailing piles and turbidity) is common throughout the river segment. Twenty-one active dredges were observed during a two-day float. The greatest activity and substrate disturbance is in the upper five miles from Oxbow Reservoir to Cache Rock where 15 dredges were observed. Since the survey was conducted at the beginning of the dredging season, dredging activity probably increases greatly through the summer (FWS 1991).

Historical records of fish resources in the Middle Fork are also limited. California Department of Fish and Game records of stream surveys done in 1938 prior to Folsom Dam construction indicate a variety of species present. In addition, records indicate that rainbow and brown trout were stocked from 1930-1949 and then again in the mid-1960's (post-Folsom Dam). Compared to the North Fork, the Middle Fork has a much greater relative abundance of coldwater species vs warmwater species (FWS 1991).

A fish sampling survey conducted by FWS along the Middle Fork American River between September 20-28, 1989 identified 18 Sacramento hitch, 10 Sacramento sucker, 11 Sacramento squawfish, 2 riffle sculpin, 4 brown trout, 3 rainbow trout, and 3 which could not be identified (FWS 1991).

In summary, the North Fork American River from the Auburn dam site to the Colfax-Iowa Hill Bridge contains about 20 miles of free flowing stream habitat and 5 miles of

reservoir habitat (Lake Clementine) suitable for warmwater fish production. Major disturbances appear to have been caused by instream mining and the washed out Auburn coffer dam. In contrast, the Middle Fork American contains about 24 miles of free-flowing stream habitat suitable for both warmwater and coldwater fish, the coldwater habitat being a consequence of the Middle Fork American River project. Instream mining appears to be a major disturbance factor in this reach (FWS 1991).

The effects of a 200-year sized detention dam on sediment transport were analyzed to help in the design of the dam and outlet configuration. This draft report ("Geomorphic, Sediment Engineering and Channel Stability Analysis, Resource Consultants and Engineering," 1993) compared the base (no-action) condition to a detention dam with 12 sluice gates. This was done to learn how sediment would affect the sluices and gates. This study looked at the quantity and size of the material being transported by the river. Where the material would likely be deposited during high flows under the base and project conditions was also evaluated. As a result of this study, the number of sluices has been increased from 12 to 20. Operation of the gates to minimize drawdown induced sloughing has been also been added.

The river in the study area is divided into a series of reaches between geologic or man-made features which restrict flows in the channel causing bars to form from the bed load materials. On the Middle Fork Reach 1 extends from the upstream limit of the project area at RM 21.0 (near Oxbow Dam) to RM 66.5; Reach 2 extends downstream to RM 62.2 the upstream end of the pool caused by Landslide Rapid; Reach 3 consists of the pool behind Landslide Rapid and extends downstream to RM 61.2 ; Reach 4 extends from Landslide Rapid to Greenwood Bridge at RM 59.3; Reach 5 extends from Greenwood Bridge to the upstream end of the pool formed by Mammoth Bar at RM 54.1; Reach 6 extends downstream to Murderers Gulch at RM 52.4; Reach 7 extends from Murderers Gulch to the confluence with the North Fork at RM 50.3; Reach 7a includes the North Fork up to North Fork Dam; Reach 8 is from the confluence and the dam site at RM 47.2. Approximately 90 per-cent of the sediment in the project area consists of medium to coarse gravels and cobbles, with the remainder divided between coarse sand, fine gravel, and boulders.

The study estimates that under "normal" conditions, approximately 14,500 tons of sediment are delivered as bed load on an average annual basis in the Middle Fork project area, and the North Fork delivers an additional 1,700 tons. The difference between the amount of sediment delivered by the two forks is a result of the North Fork Dam and Lake Clementine which traps most of the sediment coming down the North Fork. A total of 16,900 tons is delivered past the dam site annually, showing that the system is degradational, losing approximately 700 tons annually. For detention dam conditions, the annual delivery from the North Fork is reduced to approximately 110 tons and the amount passing through the dam sluices would be approximately 13,500 tons, indicating that the system would accumulate approximately 1,100 tons in the study area (Resource Consultants and Engineering, 1993).

During a 200-year storm, the relative sediment balance changes significantly. Approximately 560,000 tons of sediment would be delivered by the Middle Fork and approximately 270 tons would be delivered by the North Fork, of this total approximately 265,000 tons would be carried past the dam site. This indicates that the project area is aggradational, accumulating about 295,207 tons during a 200-year storm without the dam in place. With a dam in place the North Fork would deliver approximately 40 tons and the amount passing the dam site would be 70 tons, increasing the aggradation to 560,000 tons. Given the tendency for material to accumulate upstream of constrictions such as Mammoth Bar and channel blockages such as Landslide Rapids or the detention dam, it is likely that sedimentation and bar formation would continue at the same general locations in the future whether the project is in place or not. The exact location and quantity of sediment deposited would be greater with the dam in place (Resource Consultants and Engineering, 1993).

To minimize the impacts to the riverine resources such as the existing riffle pool complex along the river, and impacts to vegetation on the canyon walls from drawdown induced sloughing during an inundation event, the number of sluices was increased from 12 to 20, and operation of the gates was also added.

The change in design and operation of the dam has made the without and with project conditions much closer, significantly reducing the affects of sedimentation on the aquatic environment and the limited fisheries resources in the project area. With a dam in place, sediment would be transported during the early part of a storm when the water is contained in the stream channel. As flows increase and the water begins to back up behind the dam, sediment in the water would start to settle out. When the storm passes and the drawdown begins, the flow rate would accelerate as the water returns to the channel. This acceleration of flows would again transport sediment downstream until the velocities were not sufficient to move the bed load. The second episode of sediment transport would somewhat cleanse the material deposited during the impoundment.

During February 1986, a 2-day average flow of 46,000 cfs was measured at the Foresthill gaging station, and water depths of 30 feet were noted at high-water marks on the canyon wall. Flows were estimated to have velocities of 20 to 25 feet per second. This storm was calculated to have a return frequency of about a 67-year storm. During a 200-year storm, it is calculated that peak inflows past the damsite would be about 300,000 cfs. Model runs indicate that this would result in water depths of approximately 60 feet. For a 400-year storm, peak inflows would be about 510,000 cfs and water depths about 68 feet. Flows of this magnitude would likely result in all but the most sheltered fish being swept out of the river into Folsom Reservoir. Flows of this magnitude would also cause the cobbles and sediment in the riverbed to move and be redeposited into new bars or at the existing bars along the river

Upper Sacramento River

The regional setting for fisheries analyses includes the upper Sacramento River area (including the upper reaches of the river, Shasta and Keswick Reservoirs, and Clair Engle

Reservoir on the Trinity River). This subsection describes aquatic habitats and fisheries resources within this general area.

Shasta and Keswick Reservoirs. Shasta Dam and Reservoir are located about 15 miles north of the City of Redding, Shasta County, in northern California. Shasta Reservoir stores and releases flows of the Sacramento, Pit, and McCloud Rivers. Keswick Dam, about 9 miles downstream from Shasta Dam, regulates releases of water into the upper Sacramento River, including those from Shasta Reservoir and those imported from the Trinity River through the Spring Creek Tunnel.

Shasta Reservoir is a deep reservoir supporting a wide variety of warmwater and coldwater fishes. Seasonal water-surface elevation fluctuations of the reservoir are extreme, averaging 55 feet. In addition to fluctuations in water-surface elevation, the littoral zone (shallow water near shoreline area) aquatic habitat areas are subject to disruption resulting from wave action caused by wind and boats. Shasta Reservoir is a "two-story" impoundment, supporting a warmwater fishery in the upper warmwater layer epilimnion and a coldwater fishery in the colder lower layer hypolimnion. Fish inhabiting the reservoir include several species of trout, landlocked salmon, largemouth and smallmouth bass, channel catfish, white catfish, threadfin shad, Sacramento sucker, Sacramento squawfish, and common carp.

The area between Shasta and Keswick Dams is characterized as a coldwater impoundment supporting a good rainbow trout sport fishery and a brown trout fishery. Keswick Dam is a complete barrier to the upstream migration of anadromous fish. Anadromous fish are those which spawn in freshwater rivers or streams, migrate and develop as juveniles within freshwater and estuarine environments, spend the majority of their adult life stage in the open ocean, and return to freshwater to spawn. Migrating anadromous fish impeded by the structure are transported to the Coleman National Fish Hatchery (Reclamation, 1991) on Battle Creek (southeast of the town of Anderson).

Clair Engle Reservoir. Clair Engle Reservoir is also thermally stratified, providing both warmwater and coldwater habitats. Common fish species in the reservoir include small- and largemouth bass, white catfish, and rainbow trout (Corps, 1991).

Upper Sacramento River. The upper Sacramento River, extending from the Red Bluff Diversion Dam upstream to Keswick Reservoir (approximately river mile 243 to 302), has been significantly altered by the construction (in 1945) and operation of Shasta Reservoir. Regulated flows have affected water temperatures and flows within the Sacramento River. Construction of Keswick Dam (1950) resulted in the historical spawning grounds of the winter-run chinook salmon becoming inaccessible. The upstream portion of this reach of the river has not been altered extensively by the levees and bank revetment. As a result, the river is natural, with typical riverine features such as riffles, runs, glides, and pools. Conversely, the lower reaches of the upper Sacramento River have been significantly altered by regulated flows from Shasta Reservoir; these flows have affected water temperature and flow regimes in the river.

The upper reach of the Sacramento River supports both warmwater and coldwater fish species. Resident species include rainbow and brown trout, largemouth and smallmouth bass, channel catfish, sculpin, Sacramento squawfish, Sacramento sucker, hardhead, and common carp (Reclamation, 1991). This reach of the Sacramento River is of primary importance to anadromous species (Reclamation, 1991) and serves as the primary spawning grounds of winter-run chinook salmon. In addition to winter-run chinook salmon, three other races of chinook salmon (fall, late fall, and spring runs) inhabit the upper Sacramento River. Thus, various life stages of the four races of chinook salmon can be found in the upper Sacramento River throughout the year.

Downstream from American River

For purposes of fisheries analyses, the lower Sacramento River area includes the lower reaches of the river and the Sacramento-San Joaquin Delta. This subsection describes the aquatic habitat and fisheries resources potentially affected by the project in this general area. Table 4-2 lists fishes of the lower Sacramento River.

Lower River. A significant portion of the lower river is leveed and bordered by agricultural land (DFG, 1988). Aquatic habitat is represented by a meandering, channelized, depositional section of the river which is characterized by poor water clarity and little habitat diversity. Fish species composition of the lower portion of the Sacramento River is similar to that of the upper Sacramento River, including resident and anadromous fishes and warmwater and coldwater species. Anadromous fish, such as chinook salmon, striped bass, American shad, and sturgeon, primarily use this section of the Sacramento River as a migration route to upstream spawning areas, although this section of the river does contain limited suitable spawning habitat.

Sacramento-San Joaquin River Delta. Historically, the Delta was a lowland marsh dominated by tules and other types of aquatic vegetation. Because of varying flows from the Sacramento and San Joaquin Rivers, water salinity and volume were constantly changing. In the mid-1800's, the construction of levees began to protect the increasingly populated area from floodwaters. The levees also protected the many agricultural areas. Because much of the Delta is now protected by these levees, additional habitat has been altered by human development.

The Delta connects to San Francisco Bay, and together the area comprises the largest estuary on the west coast (EPA, 1993). Its importance to fisheries is illustrated by the over 120 fish species which rely on its unique habitat characteristics (EPA, 1993). Fish species in the Delta include anadromous species (chinook salmon and steelhead trout), Delta smelt (Federally listed as threatened) and Sacramento splittail (proposed for threatened status), in addition to several species which can tolerate a wide range of water salinities.

TABLE 4-2

Fishes of the Lower Sacramento River

Common Name	Scientific Name
Anadromous Game Fish	
Chinook salmon	*Salmon gairdneri gairdneri*
Steelhead	*Oncorhynchus kisutch*
Silver salmon	*Oncorhynchus gorbuscha*
Pink salmon	*Oncorhynchus keta*
White sturgeon	*Acipenser transmontanus*
Warmwater Game Fish	
* Spotted bass	*Micropterus punctualatus*
* Largemouth bass	*Micropterus salmoides*
* Smallmouth bass	*Micropterus dolomieui*
* Warmmouth bass	*Lepomis gulosus*
* Green sunfish	*Lepomis cyanellus*
* Bluegill	*Lepomis machrochirus*
* Redear sunfish	*Lepomis microlophus*
* White crappie	*Pomoxis annularis*
Sacramento perch	*Archoplites interruptus*[1]
* Channel catfish	*Ictalurus punctatus*
* White catfish	*Ictalurus catus*
* Brown bullhead	*Ictalurus nubulosus*
* Black bullhead	*Ictalurus melas*
Nongame Fish	
Sacramento western sucker	*Catostomus occidentalis*
* Carp	*Cyprinus carpio*
* Goldfish	*Carassius auratus*
Sacramento blackfish	*Orthodon microlepidotus*
Hardhead	*Mylopharodon conocephalus*
Sacramento hitch	*Lavinia exilicauda*
Sacramento squawfish	*Ptychocheilus grandis*
Sacramento Splittail	*Pogonichthys macrolepidotus*[2]
* Mosquitofish	*Gambusia affinis*
Tule perch	*Hysterocarpus traski*
Riffle sculpin	*Cottus gulosus*
Pacific lamprey	*Engonsphenus tridentatus*
* Threadfin shad	*Dorosoma petenense*
* Golden shiner	*Notemigonus crysoleucas*
* Fathead minnow	*Pimephales promelas*
Western roach	*Hesperoleucas symmetricus*
Sacramento tui chub	*Gila bicolor*
Spreckled dace	*Rhinichthys osculus*
* Log perch	*Percina macrolepida*

Source: Modified from Gerstung, 1971.
*Introduced species
[1]Possibly extirpated
[2]Federal Candidate, Category 2

VEGETATION AND WILDLIFE

The vegetation affected by the project ranges from the agricultural landscape of the lower Sacramento River area to the various forests in the upper American River.

Lower American River and Folsom Reservoir

Lands along the American River were often flooded prior to construction of the lower American River levee system. Perennial and seasonal freshwater marshes and riparian habitat occupied what is now the Sacramento metropolitan area. Settlement and development disrupted these natural processes. Flood prevention and land reclamation allowed the flood plain areas of the lower American River to be developed. Today, the lower American River flows 23 miles through the American River Parkway (FWS, 1990).

Folsom Reservoir, Lake Natoma, and the lower American River area extend across a natural transition zone from the higher elevation habitats of the lower Sierra foothills to the valley floor. Although the lower American River area contains the same vegetation cover types as Natomas, the distribution pattern differs from that in Natomas. Lands adjacent to Folsom Reservoir are characterized by savanna grassland and live oak woodland; marsh, riparian scrub-shrub and forest, woodland, and grassland dominate the lower American River along the parkway.

A wetland inventory along the lower American River area concentrated on the parkway area downstream from Goethe Park to the confluence, the area where flood control features have been identified. The lateral limit of the surveyed corridor was defined by the levees. Specifically, wetlands above the average high-water line were targeted. Approximately 655 acres of wetlands were found along the parkway.

However, two vegetation cover types, oak-woodland and grassland, limit overall species diversity in the Folsom Reservoir area. The oak woodland provides an abundance of trees for nesting and observation sites for red-tailed hawks, American kestrels, and other raptors. The evergreen oaks supply a food source for mast eaters such as acorn woodpecker, scrub jays, black-tailed deer, ground squirrels, and gray squirrels (FWS, 1991). The shrub layer provides cover for many species of songbirds, California quail, bobcat, coyote, gray fox, and rodents (FWS, 1991). Other characteristic wildlife of this ecosystem include the raccoon, opossum, bats, western skink, and king snake.

The grassland areas in the Folsom Reservoir area serve as the food base for a wide variety of herbivores such as the kangaroo rat, meadow mice, pocket mice, and pocket gophers. These species provide food for the carnivorous species of the area, which include owls, hawks, coyote, gray fox, gopher snakes, and the Pacific rattlesnake. The Lake

Natoma area supports the same wildlife species as are found along the lower American River (FWS, 1991).

The lower American River and parkway area support diverse wildlife populations. The high species diversity in the parkway results from the amount, variety, and quality of habitat and existing protective management measures. Each of the five vegetative cover types is valuable to wildlife. They provide for permanent residency and breeding and serve as a migratory corridor or a buffer from urban developments. Riparian forests are the most significant for wildlife. Their tremendous decline statewide makes them especially significant.

More than 220 species of birds have been recorded along the parkway, and over 60 species nest in Central Valley riparian habitats (FWS, 1991). Common species along the floodway include the great blue heron, mallard, red-tailed hawk, red-shouldered hawk, American kestrel, California quail, killdeer, belted kingfisher, scrub jay, northern flycatcher, tree swallow, and American robin. More than 30 species of mammals also reside along the floodway, including striped skunk, Virginia opossum, brush rabbit, raccoon, western gray squirrel, California ground squirrel, meadow vole, muskrat, black-tailed deer, gray fox, and coyote (FWS, 1991). Additionally, reptiles and amphibians depend on the indigenous habitats of the lower American River. The most common include the western toad, Pacific tree frog, bullfrog, western pond turtle, western fence lizard, southern alligator lizard, western skink, common garter snake, and gopher snake (FWS, 1991).

Field sampling in conjunction with the HEP evaluation provided a relative rating of the value of the various cover types based on representative species typically occupying various feeding and/or breeding guilds within those cover types (Corps, 1994; FWS, 1994). A complete list of species was chosen by the HEP team and, along with a description of the habitats these species represent, can be found in the FWS Coordination Act Report (appendix J).

The HEP analysis was divided into two subanalyses, construction impacts and operational impacts of reoperating Folsom Dam. This subdivision was made because of the differences in data used for analysis (that is, project feature construction data, such as length and width of construction footprints, were used for the construction impact analysis. Hydraulic data were used for the operational impact analysis and consisted of peak flow-frequency curves, rating curves, and cross-section elevations). In addition, the two subanalyses correlate into different resource categories into which the cover types were placed and the related compensation goals. (See appendix J, Coordination Act Report, for further explanation.)

Upper American River

The study area encompasses 42,000 acres along the steep canyons of the North and Middle Forks of the American River, which are within the project area for the authorized multipurpose Auburn Dam. However, only a portion of this area (less than 5,500 acres) would be inundated after construction of a flood detention dam.

Historically, the riverbed and bars of both the Middle and North Forks of the American River were explored for mining as early as the summer of 1848. Thousands of miners, working alone or for mining companies, invaded the canyons of the upper American River. They worked their way up from Oregon Bar to the confluence of the Middle and North Forks and then up each fork. Placer mining predominated in the beginning, but as more miners arrived, they formed mining companies and worked the river gravels. The methods they employed called for diverting the river with wing dams and flumes to expose the riverbed for mining. The river gravels were dredged and washed in pans or sluices. Before long, another mining method came into use in the upland areas. To recover gold from older gravel deposits, the miners used hydraulic hoses to blast the gravel from the hillsides.

In general, the portions of the American River canyon in the study area have been subjected to intensive exploitation and destruction. Once the gold had been removed, river gravels were left piled on the banks of the river. Hydraulic debris washed down the streams, depositing sediment along the way. This was common along the Middle Fork. However, the North Fork Dam was specifically built to capture this debris on the North Fork of the river.

The areas disturbed by the mining boom were eventually abandoned and left to recover on their own. Vegetation has regenerated extensively, and the area provides little visual evidence of its previous degradation (Turner, 1983).

The study area serves as a transition zone between middle elevation foothill grassland, hardwood woodland and forest communities, and the higher montane, largely evergreen conifer-dominated forest communities. This wide range of physiographic and microclimatic environments provides a diverse and complex vegetation mosaic. Forest dominants in the study area vary among deciduous broadleaved trees, evergreen broadleaved trees, evergreen coniferous trees, and other combinations. Riverine riparian vegetation along the main river corridor includes large areas of flowing open water, rocky shoreline, sand and gravel bars, river-edge willow and shrub thickets, many stands of tall moist forest of varied ages, higher terrace grasslands, and mixed riparian thickets.

Jurisdictional wetlands were identified in the upper American River in June and July of 1990. Wetlands were not found above the high-water mark. This identification focused on the inundation zone created by the 200-year storage plan. The area included the North and Middle Forks of the American River from the damsite to elevation 865 feet.

The proposed damsite and inundation zone is in a region of high wildlife species diversity (FWS, 1991). Many macro- and micro-habitats, including seeps, springs, small ponds, and pools, rock outcrops, limestone outcrops, talus slopes, cliffs, crevices, and caves, contribute to the diversity and abundance of plant and animal life in the area. Much of the area is characterized by steep, often densely vegetated slopes. The canyon bottoms provide surface moisture and associated vegetation cover critical to most area wildlife species.

Species common to this general area include black-tailed deer, coyote, raccoon, fox, and many species of reptiles and amphibians. Black-tailed deer are common in densities of 10 to 30 per square mile (FWS, 1991). Although cover and browse for deer vary from excellent to poor throughout the area, in general, conditions are good to very good (FWS, 1991). The relatively high deer populations (indicated by the extent of visibly browsed shrubs and forbs) and the extensive mosaic of fire-adapted vegetation types indicate the important and dynamic role fire plays in maintaining high habitat values in the region (FWS, 1991). Fires thin dense monotypic stands of trees and shrubs, which are often undesirable as forage, and permit seed regeneration of other species that serve as browse for wildlife.

Specifically, the north slope forest cover type provides a dense tree habitat with undisturbed drainages used for nesting and denning. Species found in this habitat include ringtail cat, grey fox, deer, owls, and many songbird species (FWS, 1991). Thick ground litter provides habitat for amphibians, reptiles, and invertebrates. The ground litter also provides habitat for woodrats and ground foraging birds. In contrast, the south slope forest is a relatively dry open area in which some of the same species of the north slope forest intermix with species more exclusive to the south slope habitat. These species include turkey vulture, bandtail pigeon, scrub jay, acorn woodpecker, various warbler species, California thrasher, and various species of vireos and sparrows (FWS, 1991). Additionally, the open sunny exposures and rocky outcrops provide habitat for the western fence lizard and other species of snakes and lizards.

The drier digger pine conifer forests provide habitat for overlap species from the nearby chaparral, such as gray fox, coyote, deer, wood rat, wrentit, scrub jay, thrasher, brush mice, badger, and bobcat (FWS, 1991). The more mesic ponderosa pine and incense cedar stands often support red fox, porcupine, mountain lion, raccoon, beaver, deer mouse, California vole, mink, and forest birds such as Townsend's solitaire, pine siskin, gnatcatcher, nuthatch, western wood pewee, various thrushes, warblers, and grosbeak (FWS, 1991).

The chaparral cover type is usually a fire-adapted type of habitat that can vary greatly in its value to wildlife. Dense stands with little ground vegetation and almost complete canopy closure present low value to wildlife compared to a recently burned area with open areas and young plants and shrubs for foraging. These open areas with available forage will support species such as wrentit, quail, turkey vulture, deer, mountain lion, bobcat, coyote, gray fox, reptiles, and songbirds. In the Auburn area, chaparral areas are not usually allowed to experience the natural fire regime because of fire avoidance and prevention. Therefore, the chaparral areas are indirectly allowed to mature to decadent, essentially

monoculture stands of one or two dominant shrubs with relatively low wildlife values (FWS, 1991).

The grassland habitats in the upper American River area vary in terms of their value for wildlife depending on the location (elevation) and size of the area. Generally, grasslands provide foraging sites for many of the species residing in the adjacent habitats, such as mammals, raptors, reptiles and amphibians.

The riverine areas along the upper American River support a high diversity of habitats (FWS, 1991). The vegetation here and at the major and minor tributaries that are adjacent to the main river provide a variety of habitats supporting many water and shore birds such as the dipper, sandpiper, great blue heron, killdeer, bufflehead, bittern, egret, mallard, merganser, goldeneye, and wood duck. Water sources near vegetative cover attract large mammals, amphibians, and reptiles such as foothill yellow-legged frog, western toad, slender salamander, California newt, western pond turtle, gopher snake, night snake, western whiptail, and common kingsnake.

Field sampling in conjunction with the HEP evaluation provided a relative rating of the value of the various cover types, based on representative species typically occupying various feeding and/or breeding guilds within those cover types (Corps, 1991/1994; FWS, 1990). For a complete list of species chosen, see the FWS Coordination Act Report (appendix J).

Upper Sacramento River

Riparian habitats historically occurred along the natural banks of the Sacramento River, the lower Feather River, the American River, and other streams in the Central Valley (Smith, 1977). Prior to human settlement, riparian forests are conservatively estimated to have covered 921,000 acres along Central Valley watercourses (Katibah, 1984). As of 1984, remaining riparian habitat was estimated at 102,000 acres, with approximately 49,000 acres considered degraded (Katibah, 1984). Major human-induced changes contributing to the decline in riparian cover include conversion to agricultural uses, logging, streambank stabilization, channelization, reduction of riverflow due to dams and irrigation, and accelerated erosion of riverbanks due to upstream dams and channelization in adjacent areas (Roberts et al., 1980).

Riparian habitats are areas of high biological productivity (Roberts et al., 1980). Many species of wildlife find optimal habitat in riparian systems, and some are entirely restricted to surviving remnants along river channels (Sanders et al., 1985; Eng, 1984; Gaines, 1977). A high diversity of bird species is supported by riparian woodlands (Gaines, 1977). Equally important are the assemblages of mammals, reptiles, amphibians and invertebrates inhabiting riparian habitats (Brode and Bury, 1984; Williams and Kilburn, 1984; Eng, 1984). Persistence of remaining riparian ecosystems is important for maintaining statewide biological diversity.

__Shasta and Keswick Reservoirs__. Habitats surrounding these reservoirs consist mainly of upland vegetation dominated by conifers. Typical species are ponderosa pine, digger pine, Douglas-fir, and blue oak. At lower elevations on moderate to steep terrain, vegetation is predominantly shrub and scrub oak. A significant drawdown zone caused by fluctuations in water-surface elevations associated with normal reservoir operations rings the reservoirs. No vegetation can become established in this zone and immediately adjacent areas because of wave action from wind and boats and the extreme water-level fluctuations. On slopes below the lake's high water line, vegetation is limited to small patches of annuals and willows in moist areas (Corps, 1991a).

__Trinity River Division__. The Trinity River Division is mainly surrounded by upland habitats dominated by conifers with some small areas of riparian habitat with deciduous species. Large stands of willow and alder often grow on the edge of watercourses. Marshes are found in slow-moving backwaters. Vegetative communities and associated wildlife closely resemble historic conditions.

Maintenance of riparian communities along the Sacramento River is dependent upon flow regimes. Historically, high intensity flows removed debris and deposited new sediments which provided suitable substrates for seed germination. Erosion and sediment deposition are therefore important factors in riparian succession along parts of the Sacramento River (Corps, 1988).

Much of the Sacramento River below Chico Landing is confined by levees stabilized by rock revetment bank protection to the detriment of the natural diversity of riparian vegetation. Agricultural land is common along the lower reaches of the Sacramento River, but less prevalent upstream from Red Bluff (DFG, 1988). Remaining areas of riparian communities consist of riparian forests composed of valley oaks, cottonwoods, wild grape, boxelder, elderberry shrubs, and some scrub areas dominated by willows. The largest and most significant tract of riparian forest remaining on the Sacramento River is a stretch between Chico Landing and Red Bluff. Freshwater, emergent wetlands occur in slow-moving backwaters. Tules, cattails, rushes, and sedges are the primary vegetation in freshwater wetlands.

Many species of terrestrial wildlife rely on the remaining strips of riparian vegetation for foraging, cover, and nesting. Typical wildlife associated with riparian areas includes songbirds, waterfowl, and mammals such as muskrat, otter, mink, and beaver.

__Downstream from American River__.

__Sacramento-San Joaquin Delta (Delta)__. Most of the vegetation in the Delta is irrigated agricultural fields. Riparian habitats persist in small areas. Freshwater and saline emergent wetlands are present but are greatly reduced from historic conditions. Vegetation in saline wetlands consists of pickleweed, cordgrasses, glasswort, and shoregrass. These wetlands are very sensitive to variations in water salinity, which is determined by waterflows into, within, and through the Delta (San Francisco Estuary Project, 1993).

The wetlands of the Delta harbor many unique and endemic species and provide important habitat for numerous shorebirds, waterfowl, reptiles, and amphibians (Mayer and Laudenslayer, 1988).

Yuba River. The vegetation along the Yuba River upstream from Englebright Dam is similar to that found in the American River canyon area which is in the foothill ecoregion. This area is included in the transition zone between middle elevation foothill grassland, oak savanna, and hardwood forest communities, and higher montane, largely evergreen conifer-dominated forest communities. The vegetative communities are basically the same as those described for the upper American River area.

ENDANGERED SPECIES

The FESA (Federal Endangered Species Act) of 1973 (50 CFR 17) provides legal protection for plant and animal species in danger of extinction and requires identification of critical habitat and development of recovery plans for such species. California has a parallel mandate embodied in the CESA (California Endangered Species Act) of 1984 and the California Native Plant Protection Act of 1977. The plant and animal species protected under FESA and CESA are listed as endangered or threatened.

Before any Federal agency can undertake an action involving modification of the environment, FESA requires that a finding be reached by the U.S. Fish and Wildlife Service concerning the potential of that action to jeopardize the continued existence of any listed species. Unless they are also listed under FESA, species listed by the State are not protected under the FESA. Under CESA, however, the DFG is empowered to review projects for potential impacts to State-listed species and their habitats.

In addition to formal endangered and threatened listings by Federal and State Governments, many other species are of special interest because of limited distribution; declining populations; diminishing habitat; or unusual scientific, recreational, or educational value. These species are not afforded the same legal protection as listed species, but may be added to official lists in the future. There are three general categories of special interest species:

- Those species that have been formally proposed for Federal or State listing as threatened or endangered;
- Those species that are candidates for Federal or State listing as threatened or endangered;
- Those species which are not candidates, but which have been unofficially identified as a species of special interest by private conservation organizations or local governmental agencies.

Federal candidate species are assigned to one of three categories depending upon the state of the information base concerning the biological appropriateness for listing those species. FC1 (Federal Category 1) includes species for which the FWS has compiled substantial information indicating that, in terms of biological vulnerability and magnitude of threat, endangered or threatened status may be warranted. FC2 (Federal Category 2) includes species for which the existing base of information is incomplete, but which appear, based on the information that is available, to warrant continued consideration for listed status. FC3 (Federal Category 3) includes species which have been evaluated and a determination made that listing is not warranted. Table 4-3 shows species protected under the FESA and CESA that are most likely to be present in the study area.

Pursuant to Section 7 of the FESA, the Corps submitted a biological assessment and biological data report to FWS. Based on information contained in that report and other information, FWS will issue a determination of jeopardy or nonjeopardy for each species and issue a formal biological opinion. If a finding of jeopardy is reached, FWS will identify reasonable and prudent alternatives to avoid jeopardy. Based upon this information, appropriate mitigation measures will be developed and implemented.

Several sensitive species are present in the project area. Federally listed, State-listed, and Federal candidate 1 and 2 species potentially found in the American River basin are presented in appendix K. For the detention dam plan, habitats in the North and Middle Fork American River canyons extending upstream from the Auburn Dam site are the most likely to be affected. For project alternatives involving modified Folsom Reservoir operations, near-shore habitats along the lower American River, Lake Natoma, and Folsom Reservoir are the most likely to be affected, with the probability and magnitude of potential impacts decreasing with increased distance from the water's edge. The western spadefoot toad, Boggs Lake hedge-hyssop, Eldorado bedstraw, legenere, saw-toothed lewisia, and Stebbin's phacelia do not grow in these habitats and will not be affected by the project. These species will not be discussed further.

Winter-run Chinook Salmon

Winter-run salmon are distinguished from other runs of chinook salmon in the Sacramento River by the timing of their upstream migration and spawning season. They return almost exclusively as 3-year-olds to the river for spawning, after maturing in the ocean. Upstream migration extends from mid-November to mid-July. The bulk of the fish spawn in May and June in the main stem of the Sacramento River upstream from Red Bluff. Juvenile seaward migration begins in July and continues through December. Winter-run chinook salmon require clean, free-running water for migration, spawning, and rearing. The winter-run salmon has been recorded at river mile 16 of the lower American River. The different runs of salmon are hard to distinguish by sight alone. Genetic testing, which has not been completed, is necessary to confirm this information.

Table 4-3

Listed, Proposed, and Candidate Species Occurring or With Potential to Occur in the Project Area

Species	Status[a] Federal	Habitats	Occurrence in Project Area
Fishes			
Winter-run chinook salmon *Oncorhyncus tshawytscha*	T/--	Riverine	Occurs in the Delta and along the Sacramento River
Delta smelt *Hypomesus transpacificus*	T/--	Estuarine	Occurs in the Sacramento-San Joaquin River Delta
Steelhead trout *Oncorhynchus mykiss*	P/--	Riverine	Occurs in Sacramento and American Rivers
Sacramento splittail *Pogonichthys macrolepidotus*	PT/--	Estuaries, lakes, and rivers of the Central Valley	Occurs in the Sacramento-San Joaquin River Delta
Longfin smelt *Spirinchus thaleichthys*	C2/--	Estuarine	Occurs in the Sacramento-San Joaquin River Delta
Green sturgeon *Ascipenser medirostrus*	C2/--	Estuarine and riverine	Occurs in the Sacramento River and Delta
Pacific lamprey *Lampetra tridentata*	C2/--	Estuarine and riverine	Occurs in the Sacramento and American Rivers and Delta
Invertebrates			
Vernal pool fairy shrimp *Branchinecta lynchi*	T/--	Vernal pools and other seasonal freshwater wetlands	No known occurrences; project area lacks suitable habitat
Vernal pool tadpole shrimp *Lepidurus packardi*	E/--	Vernal pools; ephemeral stock ponds	No known occurrences; project area lacks suitable habitat
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T/--	Riparian and oak savanna habitats with elderberry shrubs	Occurs in lower and upper American River, Sacramento River, and Yolo Bypass
Sacramento Valley tiger beetle *Cicindela hirticollis abrubta*	C2/--	Sand deposits associated with aquatic environments	Recorded from the Sacramento River downstream from American River and from the lower American River
Shirttail Creek stonefly *Megaleuctra sierra*	C2/--	Shallow, fast flowing, mossy riffles	Known to occur only in Shirttail Creek, a tributary of the North Fork American River
Gold rush hanging scorpionfly *Orbittacus obscurus*	C2/--	Dense riparian forests	Lower American River and along the North and Middle Forks of the upper American River
Spiny rhyacophilan caddisfly *Rhyacophila spinata*	C2/--	Well-aerated riffles in clear, cold, swift streams	Known only from small tributaries of the upper American River, just below Forest Hill
Sacramento anthicid beetle *Anthicus sacramento*	C2/--	Found in sand slip-faces among willows	Potential for occurrence along Sacramento River downstream from American River

Species	Status[a] Federal	Habitats	Occurrence in Project Area
Delta green ground beetle *Elaphrus viridus*	T/--	Sparsely vegetated edges of vernal lakes and pools	No known occurrence
Amphibians and Reptiles			
California red-legged frog *Rana aurora draytoni*	PE/SS C	Permanent and semipermanent aquatic habitats, such as creeks and cold water ponds, with emergent and submergent vegetation and riparian species along the edges; may estivate in rodent burrows or cracks during dry periods	No recent occurrences; suitable habitat along tributary streams of upper American River but considered extirpated from the area
Foothill yellow-legged frog *Rana boylei*	C2/SS C	Creeks or rivers in woodlands or forests with rock and gravel substrate and low overhanging vegetation along the edge; usually found near riffles with rocks and sunny banks nearby	No recent occurrences; suitable habitat along tributary streams of upper American River
Northwestern pond turtle *Clemmys marmorata marmorata*	C2/SS C	Woodlands, grasslands, and open forests; occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation	Occurs along upper and lower American River
Giant garter snake *Thamnophis couchi gigas*	T/T	Sloughs, canals, and other small waterways where there is a prey base of small fish and amphibians; requires grass banks and emergent vegetation for basking and areas of high ground protected from flooding during winter	Occurrences in Natomas Basin and Yolo Bypass
Birds			
White-faced ibis *Plegadis chichi*	C2/SS C	Prefers freshwater marshes with tules, cattails, and rushes, but may nest in trees and forage in flooded agricultural fields, especially flooded rice fields	Occasionally occurs in the Yolo Bypass
Aleutian Canada goose *Branta canadensis leucopareia*	T/--	Roosts in large marshes, flooded fields, stock ponds, and reservoirs; forages in pastures, meadows, and harvested grainfields; corn is especially preferred	Rare occurrences in Yolo Bypass
Bald eagle *Haliaeetus leucocephalus*	E/E	In western North America, nests and roosts in coniferous forests within 1 mile of a lake, reservoir, river, or the ocean	Winters at Folsom Reservoir; occasionally observed along American River
Swainson's hawk *Buteo swainsoni*	--/T	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields	Nests along Sacramento River, Natomas Basin, and Yolo Bypass

Species	Status[a] Federal	Habitats	Occurrence in Project Area
American peregrine falcon *Falco peregrinus anatum*	E/E	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large populations of other bird species	Occasional winter occurrences in Yolo Basin and along American and Sacramento Rivers
Mountain plover *Charadrius montanus*	C2/SS C	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grainfields	Occasional winter occurrences in Yolo Bypass
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	--/E	Wide, dense, riparian forests with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley oak riparian habitats where scrub jays are abundant	No known occurrences in project area
Western burrowing owl *Athene cunicularia hypugea*	C2/SS C	Rodent burrows in sparse grassland, agricultural edges, roadsides, and desert habitats	Occurs in Yolo Bypass
California spotted owl *Strix occidentalis occidentalis*	C2/SS C	Mature forest with permanent water and suitable nesting trees and snags; in southern California, nearly always associated with oak and oak-conifer habitats	No known occurrences
Bank swallow *Riparia riparia*	--/T	Nests in bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam to allow digging	Four recently active colonies along lower American River
Tricolored blackbird *Agelaius tricolor*	C2/SS C	Nests in dense colonies in emergent marsh vegetation such as tules and cattails or upland sites with blackberries, nettles, thistles, and grainfields; nesting habitat must be large enough to support 50 pairs; probably requires water at or near the nesting colony; requires large foraging areas, including marshes, pastures, agricultural wetlands, dairies, and feedlots where abundant insect prey are available	Occasional occurrences in Yolo Bypass
Mammals			
Fringed myotis *Myotis thysanodes*	C2/--	Open woodlands	No known occurrences; potential along upper American River
Long-eared myotis *Myotis evotis*	C2/--	Woodlands	No known occurrences; potential along upper American River
Small-footed myotis *Myotis ciliolabrum*	C2/--	Open stands in forests and woodlands, as well as shrublands; uses caves, crevices, and abandoned buildings	No known occurrences; potential along upper American River

Species	Status[a] Federal	Habitats	Occurrence in Project Area
Long-legged myotis *Myotis volans*	C2/--	Most common in woodlands and forests above 4,000 feet, but occurs from sea level to 11,000 feet	No known occurrences; potential along upper American River
Pale big-eared bat *Plecotus townsendii pallescens*	C2/SSC	Mesic habitats; gleans insects from brush or trees and feeds along habitat edges	No known occurrences; potential along upper American River
Plants			
Layne's butterweed *Senecis layneae*	PE/R	Found primarily in gabbroic and serpentine substrates in northern mixed chaparral, serpentine chaparral, and foothill pine woodland	No occurrences in the project area; nearest occurrences along South Fork of the American River
El Dorado bedstraw *Galium californicum*	PE/R	Restricted to gabbroic substrates in shaded spots in northern and mixed chaparral and oak woodland	No occurrence in the project area; nearest known occurrences are along the South Fork of the American River
Nissenan manzanita *Arctostaphylos nissenana*	C2/--	Grows on metamorphic substrates in chaparral habitats	No occurrences in the project area; nearest known occurrences are along the South Fork of the American River.
Red Hills soaproot *Chlorogalum grandiflorum*	C2/--	Gabbroic and serpentine substrates in northern mixed chaparral, serpentine chaparral, and foothill pine woodland	No occurrences in the project area; nearest known occurrences are along the South Fork of the American River
Saw-toothed lewisia *Lewisia serrata*	C2/--	North-facing moss-covered cliffs above 3,000 feet in mixed evergreen and Sierran coniferous forests	No occurrences in the project area; nearest known occurrences are above 3,000 feet along the upper American River
Stebbins' phacelia *Phacelia stebbinsii*	C2/--	Sierran coniferous forest between 2,000 and 4,800 feet	No occurrences in the project area; nearest occurrences are in the canyon of the north fork of the Middle Fork American River above 2,000 feet
Valley sagittaria *Sagittaria sanfordii*	C2/--	Ponds, marshes, and slow-moving waters of streams, canals, and ditches	Occurs in the flood plain of the lower American River between Howe Avenue and State Route 160
El Dorado mule ears *Wyethia reticulata*	C2/--	Northern mixed chaparral and oak woodland	No occurrence in the project area; nearest occurrences are along the South Fork American River
Northern California black walnut *Juglans hindsii*	C2/--	Riparian woodlands	Flood plains of the Sacramento and American Rivers; no native occurrences
Palmate-bracted bird's beak *Cordylanthus palmatus*	E/--	Saline-alkali soils in seasonally flooded alkali sink scrub habitats	No occurrences in the project area; nearest occurrence is Yolo County, 10 miles northwest of the American and Sacramento River confluence
Antioch Dunes evening primrose *Oenothera deltoides*	E/--	Loose or semistabilized sand	No occurrence in the project area
Crampton's tuctoria/Solano grass *Tuctoria mucronata*	E/--	Clay bottoms of drying vernal pools and lakes surrounded by grasslands	No occurrence in the project area

Species	Status[a] Federal	Habitats	Occurrence in Project Area
Stebbins' morning-glory *Calystegia stebbinsii*	C2/E	Chaparral and cismontane woodland communities on serpentine or gabbroic substrates	No occurrences in the project area
Pine Hill ceanothus *Ceanothus roderickii*	C1/R	Chaparral and oak woodland	No occurrences in the project area
Pine Hill flannelbush *Fremontodendron californicum*	C1/–	Chaparral and oak woodland	No occurrences in the project area
Colusa grass *Neostaphia colusana*	PT/E	Vernal pools	No occurrence in the project area
Slender orcutt grass *Orcuttia tenuis*	PT/–	Vernal pools within valley grassland and blue oak woodland communities	No occurrences in the project area
Sacramento orcutt grass *Orcuttia pilosa*	PE/–	Vernal pools in valley grassland and blue oak communities	No occurrences in the project area

[a]Status definitions:

Federal

E = listed as endangered under the Federal Endangered Species Act.
T = listed as threatened under the Federal Endangered Species Act.
PE = proposed for listing as endangered under the Federal Endangered Species Act.
PT = proposed for listing as threatened under the Federal Endangered Species Act.
P = petitioned to list as threatened under the Federal Endangered Species Act.
C1 = Category 1 candidate for federal listing. Category 1 includes species for which USFWS has on file substantial information on biological vulnerability and threat to support proposals to list them. Species that are possibly extinct are indicated with an asterisk (*).
C2 = Category 2 candidate for Federal listing. Category 2 includes species for which FWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Species that are possibly extinct are indicated with an asterisk (*). Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.
– = no designation.

State

E = listed as endangered under the California Endangered Species Act.
T = listed as threatened under the California Endangered Species Act.
SSC = species of special concern.
– = no designation.

Delta Smelt

The Delta smelt is endemic to California and the only true native estuarine species found in the Delta. The Delta smelt is adapted to living in fresh and brackish water with salinities below 2 grams per liter. Typically, they are most abundant in the entrapment zone where incoming saltwater and outflowing freshwater mix.

Delta smelt historically congregated in upper Suisun Bay and Montezuma Slough when flows in the Sacramento and San Joaquin Rivers were high. Because of substantial human-caused changes in the relative ratios of seasonal freshwater outflows, the center of Delta smelt abundance has shifted since 1981 to the Sacramento River channel in the Delta. The

smelt is now rare in Suisun Bay and virtually absent from Suisun Marsh where they once were seasonally common.

Steelhead Trout

Habitat requirements for the steelhead trout are similar to those of the chinook salmon, and in the Sacramento-San Joaquin River system, steelhead spawn and rear in the same habitats used by chinook salmon. Reproducing runs of steelhead in the Central Valley are currently restricted to the Sacramento River and its tributaries.

Historically, steelhead trout spawned and reared in the most upstream portions of the Sacramento River and its perennial tributaries. There are few specific data regarding the historical steelhead trout abundance; however, data indicate that dams have resulted in a 95 percent reduction of river habitat available to anadromous fish. Steelhead population abundance has undoubtedly been reduced from historical levels.

Sacramento Splittail

Splittail are endemic to California's Central Valley, where they were once widely distributed. Dams and diversions have increasingly prevented upstream access to large rivers. The species is now restricted to a small portion of its former range. Splittail enter the lower reaches of the Feather and American Rivers on occasion; however, the species is now largely confined to the Delta, Suisun Bay, Suisun Marsh, and Napa Marsh. Spawning success of the splittail is highly dependent on freshwater outflow and the availability of shaded water habitat with submerged vegetation.

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is host-specific to elderberry shrubs, reproducing in and feeding on elderberry. Elderberry that supports the beetle is most commonly found in riparian habitat. The specific locations with the riparian system that are most likely to support the beetle are not well understood. Populations of beetle are known along the lower American (CNDDB, 1993; Jones and Stokes, 1987). Two areas of beetle critical habitat are within the project area near the lower American River. Additional portions of the lower American River are designated as essential habitat for the recovery of the beetle (FWS, 1987). The beetle has also been found in elderberry shrubs near ponds along the lower American River (Sands, 1985). Because of their obligate association with elderberry, beetle persistence is dependent on the presence of elderberry shrubs. Changes in streamflow that adversely affect elderberry plants may negatively influence the valley elderberry longhorn beetle indirectly. Individual beetles may be affected if high spring flows inundate habitat when the adult beetles emerge.

Giant Garter Snake

The giant garter snake typically inhabits sloughs, marshes, and drainage canals characterized by slow-flowing or standing water, permanent summer water, mud bottoms, earthen banks, and an abundance of preferred forage species. The giant garter snake is highly aquatic, but avoids areas of dense riparian overstory, preferring instead emergent aquatic vegetation, such as tules and cattails, and herbaceous terrestrial cover composed of annual and perennial grasses, blackberry, and mustard. This vegetation, along with burrows, undercut banks, and large rocks, provides escape cover. Because the snake must bask in the sun to thermoregulate, areas devoid of overstory shading are also necessary (ARWI, 1992).

Giant garter snakes rely on canals and ditches as movement corridors. These movement corridors are vital to migration patterns and, most importantly, for continuing genetic exchange between subpopulations. Although it is unknown how far giant garter snakes travel in a given timeframe, they have been observed in small irrigation ditches, suggesting that they have traveled a significant distance from the main canals. Giant garter snakes are active between early April to mid-October. After the first part of October, the snakes begin to search for suitable winter retreats, where they remain all winter (ARWI, 1992).

Bald Eagle

Bald eagles are typically found near open water (reservoirs, lakes, and rivers). Fish are the primary prey, and fall-run chinook salmon are a principal component of the diet of bald eagles in the project region (Detrich, 1978). Large, dead trees near open water are used for perching and are an important habitat component (FWS, 1986). Bald eagles winter fairly regularly in the vicinity of Folsom Reservoir, although generally in low numbers. Based on winter surveys conducted from 1979 through 1982, Detrich (1981, 1982) reported bald eagle numbers ranging from one to seven at Folsom Reservoir. Bald eagles are occasionally observed foraging along the lower American River (FWS, 1990a). Reoperation of Folsom Dam could diminish the suitability of Folsom Reservoir and the lower American River as bald eagle wintering habitat in two ways: (1) if the fisheries prey base is substantially reduced in Folsom Reservoir and the lower American River and (2) if perch trees are substantially lost or if the distance from the perch trees to open water substantially increases.

Swainson's Hawk

Swainson's hawks frequently nest in large cottonwoods or oaks found in riparian habitats. However, they generally forage in open habitats such as agricultural fields (Estep, 1989). Optimum habitat consists of suitable nesting trees near open foraging areas with high rodent populations (California Natural Diversity Data Base (CNDDB, 1993). In the project region, Swainson's hawks primarily nest along the Sacramento River (CNDDB, 1993; Corps, 1986). Foraging and nesting habitat, however, is available along the lower American River and

around Lake Natoma and Folsom Reservoir (FWS, 1990a). Currently, cottonwoods are declining along the lower American River due to changes in the timing of high flows and incision of the channel. If changes in the timing and intensity of high flows due to interim reoperation further diminish the regenerative capabilities of cottonwoods, suitable Swainson's hawk nesting habitat (large cottonwood trees) may be reduced. In addition, possible urban development undertaken as a result of flood protection provided by reoperation may adversely affect Swainson's hawk foraging habitat and reduce the suitability of the area for nesting.

WATER QUALITY

In April 1990, the SWRCB issued the 1990 Water Quality Assessment. That document is a statewide catalog of California water bodies, classified in one of four ways: (1) good - waters support and enhance the designated beneficial uses; (2) intermediate - waters usually support beneficial uses with an occasional degradation of water quality; (3) impaired - waters cannot reasonably be expected to attain or maintain applicable water-quality standards (an impaired condition may be obvious such as consistent and continued exceedence of adopted objectives or when beneficial uses are not protected); and (4) unknown - data concerning the condition of the water body are lacking.

In November 1993, the SWRCB issued a draft Water Quality Control Plan for the Sacramento and San Joaquin River basins. This document defines existing and potential beneficial uses of inland surface waters within the basins and presents draft water-quality objectives for inland surface waters and ground water, which include the potentially affected American and Sacramento River basins.

American River Basin

The American River's three major tributaries (the North, Middle, and South Forks) drain approximately 2,100 square miles of predominantly montane and foothill watershed. However, the final 30 miles of the river, between Folsom Reservoir and the Sacramento River, flows through densely populated portions of urban and suburban Sacramento County, including the City of Sacramento.

The variability of the watershed geography affects land uses and, ultimately, water quality. In the upper watershed, principal land uses include recreation, logging, and mining. Water-quality impacts are generally minor and limited to increased sediment loads. Along the lower American River, principal water-quality impacts, such as nutrient and trace metal loadings, result from stormwater runoff, treated sewage discharges, agricultural runoff, and other urban and agricultural land use practices. In addition, the operation of the complex system of water reservoirs, debris dams, and diversion structures affects flows and

occasionally leads to unfavorable temperatures and dissolved oxygen concentrations in the lower American River.

Historically, water quality parameters for the American River have generally been well within acceptable limits to achieve water-quality objectives and beneficial uses mandated by the Central Valley Regional Water Quality Control Board (CVRWQCB). The lower American River has periodically experienced high water temperatures that have jeopardized spawning and juvenile fish survival. These conditions generally occur in low water years when flows into the lower river are reduced.

In addition to periodic violations of hydrogen-ion concentrations and dissolved oxygen standards, taste and odor are problems in the domestic water supplies taken from Folsom Reservoir and the lower American River, primarily during the late summer. Taste and odor problems in water supplies from Folsom Reservoir are attributable primarily to blue-green algae which occasionally blooms in the reservoir as a result of elevated water temperatures. In the lower American River, similar problems are more frequent, but are the result of increased concentrations of an actinomycete microorganism which is also associated with elevated water temperatures. In both situations, control of the taste and odor problems may require increased treatment.

Water released from Folsom Reservoir is sometimes used to maintain water-quality standards in the Delta. The primary water-quality application is the use of Folsom Reservoir (and other CVP) water to offset the movement of saline water upstream.

Sacramento River Basin/Delta

The San Joaquin and Sacramento Rivers meet with the relatively minor flows of the Cosumnes and Mokelumne Rivers and merge their waters in the Delta. Water quality in the Delta is heavily influenced by a combination of environmental and institutional variables. This includes various water export facilities and agricultural activities internal to the Delta.

The two water-quality concerns in the Delta are salinity and water temperature. The principal source of salt is the Pacific Ocean via San Francisco Bay. An additional source of salt is upstream agricultural discharges to the San Joaquin River, which can sometimes create serious salinity problems in the south Delta.

Salinity intrusion into the Delta from the ocean is controlled by freshwater flows into the Delta from the Sacramento, San Joaquin, Mokelumne, Calaveras, and Cosumnes Rivers. Water development facilities upstream and within the Delta reduce winter and spring flows, so salinity levels are higher than they would be naturally. Also, during the summer and fall, water development facilities augment the natural flows into the Delta, so salinity levels are lower than they would be naturally, and the severe salinity intrusions that once were common

every summer have been eliminated. In the past, salinity sometimes intruded upstream as far as the City of Sacramento on the Sacramento River and Stockton on the San Joaquin River.

Salinity requirements to protect various beneficial water uses in the Delta are set forth in SWRCB Water Rights Decision 1485 (D-1485). Municipal and industrial water uses from the Delta are protected by the 250 ppm (parts per million) level of chlorides measured at the confluence of Old River and Rock Slough. A secondary 150-ppm standard was set at the same location for Contra Costa Canal industrial water users during a portion of the year, depending on water-year type. Agricultural water uses within the Delta are protected by an electrical conductivity standard of 0.45 mmhos (millimhos) (set at Emmaton on the Sacramento River and Jersey Point on the San Joaquin River) that is maintained for a varying number of days each year, depending on water-year type.

Salinity standards are still being reviewed for the protection of selected estuarine habitat. In addition, a variety of electrical conductivity standards have been suggested for the protection of fish, wildlife, and agriculture (SWRCB, 1992).

Water temperature in the Delta is an ongoing concern. In the summer, temperatures may range up to 70 °F, which is high for fish resources. The temperature of Delta waters is determined by a wide variety of factors that affect Delta water temperatures, including tributary inflow volume and temperature, climate and weather, extent of agricultural withdrawal or return water contributions, and riparian vegetation.

In October, 1994, California's major agricultural and urban water agencies presented a Joint Proposal for Comprehensive San Francisco Bay-Sacramento/San Joaquin Delta (Bay-Delta) Water Quality Standards to the State Water Resources Control Board (SWRCB). This proposal served as the basis for a comprehensive set of Bay-Delta standards developed in coordination with State-Federal agencies. In December, 1994, the Federal government, the State of California, water users, and environmental advocates signed a three-year agreement on new projections for the Bay-Delta entitled "Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government" (Principles) (NMFS, 1995).

The purpose of the Principles is to provide a framework for representatives of State and Federal governments and urban agricultural and environmental interest to develop a coordinated and comprehensive program of ecosystem protection through the SWRCB. SWRCB has proposed fish and wildlife objectives for the Bay-Delta Estuary based on the Principles in a draft water quality control plan. Full implementation of these objectives will occur when components have been apportioned to various water rights holders through the State's water rights process (NMFS, 1995)

In February, 1991, the National Marine Fisheries Service (NMFS) requested that the Bureau of Reclamation formally consult with NMFS pursuant to section 7 of the Endangered Species Act to determine whether its operation of the CVP jeopardized the continued existence of the threatened Sacramento River winter-run chinook salmon (NMFS, 1993).

To facilitate a better understanding of the many factors influencing the physical and institutional conditions, and decision-making processes underlying the operation of the CVP, the Bureau prepared the "Central Valley Project Operations Criteria and Plan." The objectives of the plan include:

> "Develop operational plan, including the identification of alternative operations, strategies, and criteria to meet legislative, legal regulatory, and agreement requirements. The near-term objective is to integrate Central Valley Project Water Management Program (NMFS, 1993)."

The Bureau and NMFS had intended to complete formal consultation covering long-term CVP operations under a range of hydrologic and storage conditions before 1992. However, late in 1991, NMFS and the Bureau agreed to separate the consultation regarding 1992 operations from the long-term consultation. NMFS issued a biological opinion and incidental take statement for 1992 operations that concluded that the Bureau's proposed operation of the CVP in 1992 was likely to jeopardize the continued existence of the Sacramento River winter-run chinook salmon and offered a reasonable and prudent alternative to avoid jeopardy (NMFS, 1993).

In September, 1992, the Bureau requested initiation of formal consultation on the long-term operation of the CVP. Additionally, a companion assessment by DWR was transmitted to NMFS in November, 1992. During consultation, NMFS developed biological criteria for the CVP facilities and operations that would protect Sacramento River winter-run chinook salmon. It was concluded that the Bureau was unable to meet the winter-run chinook salmon biological criteria under several operational scenarios. Additional modeling was completed to fully examine the ability of the existing CVP facilities to meet the winter-run chinook salmon biological criteria under all water-year types and storage conditions. In January, 1993, NMFS and the Bureau used the results of this additional modeling to develop modified CVP operational plans (NMFS, 1993).

In December, 1994, State and Federal agencies reached agreement on recommended water quality standards and related provisions that would remain in effect for three years. The agreement was based on a proposal developed by urban, agricultural, and environmental interests. Elements of the agreement include springtime export limits expressed as a percentage of Delta inflow, regulation of the salinity gradient in the Estuary so that a salt concentration of two parts per thousand (X2) is positioned where it may be more beneficial to aquatic life, specified springtime flows on the lower San Joaquin River to benefit chinook

salmon, and intermittent closure of the Delta cross channel gates to reduce entrainment of fish into the central Delta. A second category of provisions is intended to reconcile operational flexibility and compliance with the Federal Endangered Species Act (ESA). A third category of the provisions is intended to improve conditions in the Bay-Delta Estuary that are not directly related to Delta outflow (CALFED, 1995).

CULTURAL RESOURCES

This section focuses on cultural and paleontological resources within the study area. Specific locations of cultural and paleontological resources have been omitted in accordance with Federal and State confidentiality requirements.

Background

Prior to European contact, the Nisenan (Southern Maidu) Indians occupied the American River basin. Archeological excavations bear witness to their ancestry in this area for at least 4,000 to 5,000 years. The epidemics of 1833-36 and later the California gold rush of 1848, with its influx of settlers, were significant factors in the rapid demise of the Nisenan people. The Patwin Indians occupied portions of the study area within Yolo County. By the 1840's, Mexicans and Americans had overtaken their territory. Those who survived were either partially assimilated into the new American culture or were placed on small reservations by an Act of Congress. Today, the archeological remnants of these Native American cultures include village and campsites, rock art, seed- and acorn-grinding stations (bedrock mortars), hunting blinds, trails, and quarries (Johnson, 1978; Wilson and Towne, 1978).

One of the first Europeans to see the Central Valley was Pedro Fages on an expedition from Monterey in 1772. In 1827, Jedediah Smith is believed to have reached the American River, which he named "Wild River." Many other trappers, including several expeditions from the Hudson's Bay Company, explored the valley between the 1820's and 1840's. In 1837, California's Spanish Governor Juan Bautista Alvarado gave the wild river its current name, "Rio de los Americanos"—American River. John Sutter settled in Sacramento in 1839 and established Sutter's Fort. Much of our knowledge of the Sacramento Valley in the 1840's comes from the journals of Army Corps of Engineers officer John C. Fremont and his cartographer Charles Pruess (Woodward and Smith, 1977).

The lower American River area was included in the Del Paso land grant in 1844. Originally deeded to Eliab Grimes, the grant came into the hands of James Ben Ali Haggin and Lloyd Tevis in 1862. Haggin became famous for his horse breeding on the rancho, but the bottom lands along the river were used only for grazing.

The upper American River area experienced significant and rapid development as an outgrowth of the gold rush. Remnants of extensive mining activities still exist in the river canyons, in gulches, and along many gravel bars. The American River and other streams in the area were subjected to many reclamation and development projects after the gold rush (Kyle, 1990).

Unlike the Sacramento River, traffic up the American was usually limited to high-flow periods when steamers and other vessels could navigate a few miles upstream. To a lesser extent, lumbering, ranching, and limestone quarrying took place. The Great Depression witnessed a resurgence of gold mining and dredging. The miners of the 1930's often settled in structures or campsites originally constructed by the gold rush argonauts.

Surveys

Cultural resource surveys have been conducted along the Sacramento and American Rivers, including Folsom Reservoir, prior to the current study. These have resulted in the identification of a number of prehistoric sites within the study area; however, the entire area has not been systematically investigated. Many of the surveys date from the 1950's or earlier, and the data from them are not considered reliable in accordance with current standards.

Previously, little attention has been paid to historic structures, historic archeological sites, and navigational features such as landings, piers, and moorings along the lower American River and lower Sacramento River. Future work must include an evaluation of these historic sites in accordance with Federal law and would increase the known inventory of cultural resources within the study area.

As a result, Dames & Moore, Inc., has conducted cultural resources studies associated with project activities of the lower American River and lower Sacramento River. These activities consist of archeological and historical investigations to provide inventory level data for the Draft EIS/EIR for the American River Watershed Investigation. These studies were developed based on information provided in the Alternatives Report for the American River Watershed Investigation for the Maximum Objective Release Plan (Corps, 1994) and also included proposed borrow sites and staging areas.

Lower American River

The Area of Potential Effects for the lower American River segment was defined as direct impact areas relating to levee improvements or levee and floodwall construction (as delineated on plate 10) along a 23-mile-long corridor of the American River extending from Nimbus Dam to its confluence with the Sacramento River.

An archival records search for prehistoric and historic archeological sites was conducted for the lower American River segment in January 1995 by the North Central Information Center of the California Historical Resources File System at California State University, Sacramento. Both literature searches encompassed all project-related features, as well as a 1/4-mile-wide area adjoining each respective Area of Potential Effects. Records for the lower American River Area of Potential Effects identified 24 previously recorded prehistoric archeological sites.

Subsequent to the records search, a cultural resources inventory and site re-recordation program was initiated for the lower American River segment (Nilsson et al., 1995). This program included a pedestrian survey of 50 miles of existing and proposed levees and floodwalls, re-recordation of the 24 prehistoric archeological sites, and recordation of newly discovered sites. Potential staging areas and borrow site locations were also inventoried.

These efforts resulted in the identification and re-recordation of 42 sites, including 26 prehistoric, 13 historic, and 3 prehistoric/historic properties. The prehistoric sites include one extensive bedrock milling station and 25 habitation sites, 6 of which have been partially or completely destroyed by residential development. The historic archeological sites are comprised of four properties characterized by single concrete foundations, one historic homestead remnant, one trash scatter, three segments of the Union Pacific or Southern Pacific Railroad, portions of the Folsom (American River) Mining District, portions of the Natomas East Main Drainage Canal levee, and both the southern and northern levee systems paralleling the American River. The three multicomponent archeological sites consist of prehistoric habitation sites overlain by historic era deposits.

A historic property survey within the lower American River (Dames & Moore, 1995a) resulted in the identification of several historic or potentially historic cultural properties. RD 1000 (Reclamation District 1000 Rural Historic Landscape District) was determined eligible for the National Register in September 1994. A portion of the East Levee and the Natomas East Main Drainage Canal are within the project area. Also, a portion of the historic road alignment for the Garden Highway is located on top of the East Levee west of Northgate Boulevard. Levee Road is located on top of the East Levee east of Northgate Boulevard. East Levee, the Natomas East Main Drainage Canal, Garden Highway, and Levee Road are contributors to the RD 1000 Rural Historic Landscape District. In addition, certain pre-1944 elements of the Sacramento River Flood Control Project, including certain levees within the project area, may be eligible for listing on the National Register.

Four bridges within the project area were evaluated and two (Jibboom Street and Old Fair Oaks) were found eligible for listing. The H Street Bridge was evaluated and determined not eligible; however, Caltrans plans to reevaluate this bridge. Three potentially historic railroad bridges were identified—Northern Electric, the Western Pacific, and the Southern Pacific.

The tailings district just south of the Nimbus Dam in the American River Parkway is part of the Folsom (American River) Mining District (CA-SAC-308/H), and more research is required to determine National Register eligibility as a Historic Mining Property. A ca. 1928 farm complex at 599 Garden Highway in Discovery Park includes a house, barn, and shed. This property must be evaluated for National Register eligibility.

Several powerlines cross the parkway; at least one is older than 50 years. This property must be evaluated for National Register eligibility.

The American River Parkway is a linear park between the north bank and south bank levees of the lower American River. It begins at the Nimbus Dam and continues to the river's confluence with the Sacramento River. The concept for a parkway along the American River dates back to 1915, although a master plan for the park was not adopted until 1960. The parkway and its associated park structures are less than 50 years old; however, more research is necessary to determine if the parkway qualifies for inclusion on the National Register under Criterion Consideration G: Properties That Have Achieved Significance Within the Past 50 Years. A historic context of urban linear parkways in the 20th century, particularly those focused on rivers, is necessary to evaluate the parkway's significance.

Folsom Reservoir

Several surveys and studies have taken place since the construction of the dam. At least 123 prehistoric and approximately 52 historic era properties have been recorded. Primary archival and secondary sources suggest that more than 200 other potential sites or features may exist in the reservoir (Peak and Associates, 1990). These have not been verified in the field because of their inaccessibility below the reservoir pool. The Folsom Powerhouse received National Register listing in 1973, but no archeological sites within Folsom Lake State Historic Park have been evaluated, declared eligible, or listed. The number of potential sites in these categories will not be known until a more reliable inventory is completed.

Upper American River

Studies prepared by the University of California, Davis, for Reclamation's authorized multipurpose dam project document 1,589 historic and 125 prehistoric sites in the Auburn area (True, 1980). These prehistoric sites include villages and camps, food-processing stations (bedrock mortars), quarry sites, artifact scatters, and isolated artifacts. At least 14 known ethnographic sites are also here.

Both the North and South Forks of the American River offer testimony to a profusion of historic activity stimulated by the gold rush. Identified historic features include settlements, structures, mines, mined areas, gravel bars, ditchline segments and remnants, isolated pits or

trenches, isolated shafts and tunnels, check dams, trails, roads, bridges, wells, and unidentified ground disturbances (McCarthy, 1989).

The North Fork Dam, 5 miles above Auburn on the North Fork of the American River, was built by the Corps in 1938 to contain hydraulic mining debris. This dam, of single-arch design, is 155 feet high and 620 feet long (Hagwood, 1981). Now over 50 years old, the dam must be evaluated for National Register eligibility.

The Highway 49 replacement would be near the concrete arch bridge at Auburn, known locally as Mountain Quarries bridge, or the "No Hands" bridge. The bridge, constructed in 1911 just below the confluence of the North and Middle Forks of the American River, has been designated a Civil Engineering Landmark and is considered to be historically significant by numerous groups and individuals. However, as of August 1991 the State Historic Preservation Office had no record of a request for determination of National Register eligibility or a completed nomination form for the bridge. Now over 50 years old, the bridge must be evaluated for National Register eligibility. Five recorded archeological sites are also in the vicinity of the highway replacement.

Downstream from American River

The lower Sacramento River Area of Potential Effects was defined as portions of various levees west of the Sacramento River totaling 67 miles in eastern Yolo and northeastern Solano Counties. In January 1995, Dames & Moore researched records at the Northwest Information Center at Sonoma State University, Rohnert Park, for the lower Sacramento River. Two prehistoric sites are known to exist within the Yolo Bypass (Bouey, 1991).

Archeological surveys of the levees on both the east and west sides of the Yolo Bypass have been completed from the Sacramento Bypass south to the south fork of Putah Creek as part of the Corps Sacramento Metropolitan Area study. No prehistoric or historic sites were found, and the potential for future impacts along the levees is minimal (Glover and Bouey, 1990). Additional studies have been completed as part of the Corps Yolo Basin Wetlands study. Surveys of the area between the Yolo Bypass and Willow Slough Bypass showed no sites (Bouey, 1994). A 180-acre parcel south of Interstate 80 was surveyed in 1995 by Corps archeologists, and no sites were found (Corps, 1995).

Additional archeological investigations undertaken within the Hydraulic Mitigation Area, including a selection of levees and canals along the lower Sacramento River in Yolo and Solano Counties, resulted in the identification of one historic archeological site. This site is a 20th-century homestead in the vicinity of the Sacramento Weir and Sacramento Bypass. No prehistoric sites or isolated artifacts or features were encountered. The historic homestead site is subject to significant project-related impacts and will require National Register evaluation (Hale et al., 1995).

A historic property survey within the same area resulted in the identification of numerous properties, including pre-1944 portions of the SRFCP comprising the Sacramento Weir and the Yolo Bypass. The Sacramento Weir was determined eligible for listing on the National Register in 1976, and a study by Les in 1986 indicated that the Yolo Bypass appeared to be eligible for listing. In addition, the Sacramento Northern Railroad tracks were not part of the earlier evaluations of the Sacramento Weir, and more research on this structure is necessary. Other segments of the pre-1944 SRFCP within the project area include the Sacramento Bypass, Willow Slough Bypass, Cache Slough levees, Haas Slough levee, Lindsey Slough levees, and Miner Slough levee. More research is still necessary on certain aspects of these properties to determine their significance and integrity as elements of the portion of the pre-1944 SRFCP within the Yolo Basin. Other properties that may be eligible for the National Register but that require more research include the Sacramento Northern Railroad Trestle; Conaway Ranch Complex; Southern Pacific Railroad Trestle; Shag Slough; and complexes on Liberty Island Road, Haas Slough, Cache Slough, and State Route 84 on the eastern side of Miner Slough.

AGRICULTURE/PRIME AND UNIQUE FARMLANDS

Background

Agriculture. Historically, agriculture has played an important role in the development of the greater Sacramento area. During the late 19th and early 20th centuries, dryland farming allowed production of crops like wheat, hay, and some wine grapes. By the 1920's, gas engines and electric motors made it possible to pump ground water for irrigation, thereby increasing the amount of irrigated croplands. Technological improvements after World War II led to the conversion of large areas of land into irrigated pastures and fields for rice, corn, sorghum, strawberries, and grapes.

More recently, urbanization of the Sacramento metropolitan area has led to the loss of thousands of acres of productive agricultural land. This loss has generated substantial local concern, and agricultural preservation is an objective embraced in the general plans of all the local agencies controlling land use in the area. However, Sacramento remains subject to intense regional growth pressures, and the desire of the local land use agencies to respond constructively to these pressures forces agricultural preservation to compete with a host of other planning objectives related to urban development.

It is the responsibility of the NRCS (U.S. Natural Resource Conservation Service) to maintain and update inventories of farmlands. The Corps has coordinated with the NRCS regarding conversion of farmland in areas which were not evaluated in the 1991 FEIS/EIR. The NRCS provided Farmland Conversion Impact Ratings for these new areas. From these ratings, the Corps determined: (1) the total acreage of unique farmland to be converted by

this project; (2) the farmland conversion impact rating (out of 260 possible points); (3) the relative value of the site as farmland (on a scale of zero to 100); and (4) the total points received (out of 160) according to the site assessment criteria set forth in the Farmland Protection Policy Act. Following are definitions of the different farmland categories:

Prime Farmlands - Lands with the best combination of physical and chemical features able to sustain long-term production of agricultural crops. The land must be supported by a developed irrigation water supply that is dependable and of adequate quality during the growing season.

Unique Farmland - Lands of lesser quality soils used for the production of the State's leading agricultural cash crops. These lands are usually irrigated, but may include nonirrigated orchards or vineyards as found in some climatic zones in California.

Farmlands of Statewide Importance - Lands similar to prime farmland but with minor shortcomings, such as greater slopes or with less ability to hold and store moisture. These lands have the same reliable source of adequate quality irrigation water available during the growing season as required for Prime Farmland.

Lower American River

Three main types of soil dominate this portion of the study area—the Rincon-Marvin-Tehama association, Sycamore-Tyndall association, and Capay-Sacramento association. These diverse soils support irrigated orchards, irrigated row crops, and field crops, among others. Tomatoes, corn, rice, and sugar beets are the major irrigated crops in Yolo County. No significant agricultural lands remain in the flood plain portion of the lower American River.

Folsom Reservoir

There are no agricultural or prime and unique farmlands in the Folsom Reservoir area.

Upper American River

The upper American River area includes some agricultural lands, mostly irrigated pasture, orchards, and abandoned orchards. These lands cover some 600 scattered acres in the Cool, Pilot Hill, Lotus, Green Valley, and Greenwood areas. Also, a small plot of Christmas trees is commercially grown along Highway 49 near Cool. There are no farmlands designated as prime and unique in this portion of the project area.

Downstream from American River

Agriculture dominates the Sacramento and Yolo Bypass areas. Lands adjacent to the Sacramento Bypass are rated as prime farmland when drained. Land along the southern levee is developed. Agriculture surrounds the sloughs of the north Delta. The primary crops in the Yolo Bypass and north Delta areas include tomatoes, rice, wheat, corn, and sugarbeets.

Table 4-4 indicates the acreage in each county which may be affected by project features and the associated categories. NRCS did not differentiate between prime and unique farmlands in its evaluation of the areas.

Both the Yolo and Solano County NRCS field offices were coordinated with regarding conversion of farmland. The farmland to be converted in each county was evaluated, and the ratings are provided in table 4-5.

In accordance with the Farmland Protection Policy Act of 1981 as amended in 1994, farmland receiving a farmland conversion impact rating less than a total of 160 need not be given further consideration for protection, and alternative sites do not need to be considered.

TABLE 4-4

Existing Farmland Types
Downstream from the American River
(acres)

County	Project Area	Prime/ Unique	Statewide Importance
Solano	110	44	0
Yolo	545	375	61

One step in assigning value to the farmland is through determining if any of the sites are subject to State, local, or private policies or programs which protect farmland. Construction sites which would affect farmland are almost all held under the California Land Conservation (Williamson) Act of 1965. This is a contract and is effective for a 10-year period during which time the property cannot be rezoned or developed for other than agricultural uses.

Land with this distinction may be used for agriculture, recreation, or open-space uses. It is the county's responsibility to make the determination of other "compatible uses" to which the land may be converted and maintain its Williamson Act eligibility. Should conversion of any agricultural land held under the Williamson Act render the land ineligible for continued protection under that law, the local sponsor would be responsible for compensating the landowners.

HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE SITES

Little is known about the impacts of flooding on stored toxic and hazardous waste substances. However, some important research is currently under way on the effects of natural disasters on sites where hazardous substances are present. Preliminary information shows that flooding causes significant releases of such substances into the environment (Showalter, 1991).

Table 4-5

Farmland Conversion Impact Rating
Yolo and Solano Counties

	Scale (points)	Rating	
		Solano	Yolo
Total acreage of unique farmland to be converted		110 acres	545 acres
Farmland conversion impact rating	0-260	158	148
Relative value of the site as farmland	0-100	73	60
Total points received according to site assessment criteria of Farmland Protection Policy Act of 1981 as amended in 1994.	0-160	85	88

The significance of impacts to HTRW (hazardous, toxic, or radiologic waste) is based on both institutional and public recognition of potential public health risk if contaminants are introduced into the environment. For purposes of this analysis, any action which

substantially increases the risk of an uncontrolled release of HTRW into the environment is considered significant.

Lower American River

The literature review found over 1,430 hazardous or toxic waste sites within the flood plain area of the lower American River (Fugro-McClelland, October 1991). These sites are only those listed in the databases of State and Federal agencies involved in HTRW control. The list does not include some of the sites most vulnerable to flooding, such as small-scale aboveground chemical and petroleum storage facilities. Of the approximately 1,430 HTRW sites, about 334 could result in significant contamination if they were inundated. However, 175 of these 334 sites are considered a serious threat, regardless of potential inundation, and have been identified by Federal or State regulatory agencies for either cleanup or further monitoring. These sites are listed below by classification category. The number of sites in each category is given; however, because some sites are listed in more than one category, the totals do not add to 175. Ten of these are Federal Superfund sites in the lower American River and Natomas areas. No existing HTRW sites are in the proposed levee construction areas.

The classification categories are:

- The National Priority List. Sites in this category present a significant risk to human health and the environment and receive remedial funding under CERCLA. Two sites in this category are in the Sacramento area flood plain:

  Jibboom Junkyard
240 Jibboom Street
Sacramento, CA

  Aerojet General Corporation
Highway 50 and Aerojet Road
Rancho Cordova, CA

- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Sites listed under this program may have a potential for releasing hazardous substances into the environment. Fifteen sites in this category are in the Sacramento area flood plain.

- Federal facilities with known or suspected environmental problems included in the CERCLA database.

- California State Superfund sites as designated under the California Abandoned Sites Program Information System (ASPIS). This database is kept by the California Department of Health Services. Fifty-six sites in this category are in the Sacramento area flood plain.

- California's Cortese Act, which requires the California Office of Planning and Research to list several categories of potential and confirmed hazardous waste or substance sites. The categories on the Sacramento area flood plain are (a) leaking tanks, (b) abandoned hazardous waste sites, and (c) sites slated for cleanup over the next 5 years by the California Bond Expenditure Plan. One hundred and seventeen sites are in this category.

Landfills and solid waste transfer station sites could also cause contamination if inundated by major flooding. Six such sites in the Sacramento area flood plain are listed below.

- The Fruitridge Transfer Station at 8550 Fruitridge Road.

- The L & D Landfill Company at 8635 Fruitridge Road. This site is currently being monitored by the California Solid Waste Assessment Test Program. Sites monitored under this program contain hazardous wastes capable of escaping into the water, the air, or both. Assessment tests must be submitted to either the Regional Water Quality Control Board or the local Air Quality Management District (or Air Pollution Control District). In some instances, reports must be submitted to both agencies.

- The B & C Disposal Site at 8597 Jackson Road (Highway 16).

- The Ramona Avenue Landfill, located at Ramona Avenue and Power Inn Road. This site has been closed.

- Sacramento Waste Disposal at 360 North Street.

- The Disposal Site at 23rd and A Streets.

There are no known HTRW sites which would be affected by work at the dam or by reoperation of the reservoir.

<u>Upper American River</u>

Historically, the upper American River area was affected primarily by gold-mining activities. The gold mines in this area had their origins at or very near the beginning of the California gold rush, when miners moved from Coloma on the South Fork of the American River into the canyons of the Middle Fork. The earliest miners worked the surface and near-

surface placers along the principal streams. However, before long most of the bigger mines used hydraulic methods to mine the older gravel formations for gold, and by the late 19th century, dredges were operating in several of the principal drainages. The Sliger Mine, located on the El Dorado County side of the Middle Fork above what is believed to be Spanish Bar, was hydraulically mined from 1922 (when it was reopened) to 1937. More than 80,000 tons of ore was produced during the 4-year period from 1932 through 1935.

The concern with such mining and dredging activities is that when pyrites in the rocks are exposed to air and water, sulfuric acid is created. However, because mineralization has occurred, there is no exposed pyrite or resulting sulfuric acid formation. This may be attributable to the fact that there is very little pyrite in the rocks of the upper American River canyon. The Sliger Mine is not considered an HTRW site.

At the present time, there are few remaining small operations, and none are regulated by the Central Valley RWQCB (Regional Water Quality Control Board). Hydraulic mining has been banned for decades because it was the source of a significant sedimentation downstream. A review of the CVRWQCB's Listing of Dischargers and conversation with board staff revealed no problem active mine, abandoned mine, or tailings within the project area. No acid mine drainage problem had been documented in the past. (D. Fua, pers. com., 1991).

No HTRW sites are listed at the damsite. However, two sites near the project area—the Auburn Sanitary Landfill and the Auburn State Recreation Area tank leak—are classified as hazardous waste sites on lists of the California Regional Water Quality Control Board and the California Hazardous Waste and Substances Sites. It is unlikely that other hazardous sites are in the area. Because of the steep terrain and heavy recreational use, illegal hazardous waste sites are unlikely in the upper American River.

<u>Downstream from American River</u>

The construction areas are in Yolo County, along the Sacramento Bypass and Yolo Bypass. The surrounding land uses are primarily agricultural, and there may be agricultural chemical residue or deposits along the Yolo Bypass levees. One known former dump site adjacent to the north levee of the Sacramento Bypass was used as a sanitary landfill by the City of West Sacramento. In April 1994, staffs of The Reclamation Board and State Water Resources Control Board staff conducted a reconnaissance field survey of the landfill and prepared a report outlining a general assessment of the potential for HTRW release and recommending preventive management action. Specifically, the State report recommended that if a future levee relocation results in excavation of the landfill area or subjects it to inundation by floodwaters, the most desirable remedial action would be to relocate the landfill material to a different authorized site.

TRANSPORTATION

Background

This section describes the existing transportation system and traffic conditions in the study area. The major facilities include I-80 (Interstate 80), I-5 (Interstate 5), U.S. 50 (U.S. Highway 50), SR 99 (Highway 99), and B-80 (Business 80). Traversing the study area, I-80 provides an important transportation link between the San Francisco Bay area and Reno and other points east. U.S. 50 is an important commuter and recreational route between Sacramento and South Lake Tahoe and other points east.

Both I-5 and Highway 99 serve as vital north-south transportation spines for the State. The original I-80 route, B-80, passes through the central city area of Sacramento. Highway 49, from Oakhurst to Vinton, is a two-lane highway connecting the Auburn and Placerville vicinities in the upper American River portion of the study area. These highways connect residential locations with regional employment, commerce, and recreation areas. The central city area and the U.S. 50 and I-80 corridors are the primary employment centers. Many workers from throughout the region, including Placer and El Dorado Counties, travel to these centers during peak-commute periods, typically 7-9 a.m. and 4-6 p.m. weekdays.

Lower American River

The transportation network serving the lower American River area is radial with its major streets starting at, and then radiating outward from, the city's central business district. In the downtown area, the surface streets are laid out in a grid format. The most traveled corridors are served by one-way facilities. The areas away from downtown exhibit typical suburban roadway design with major arteries serving commercial-office-industrial corridors and providing access to the regional freeway network. A system of collector streets provides access from local residential areas to the arterial system.

The regional freeway network is dominated by four major systems: the I-5/Highway 99 system (north-south), the Highway 99/B-80 system (northeast-south), the B-80/Highway 99/U.S. 50 system (east-west), and the I-80 system (northeast-west). (See figure 4-1.) These freeways exhibit typical urban freeway characteristics, ranging from 4 to 10 lanes, with many segments elevated or depressed within the city. Certain portions of B-80 between the Cal Expo interchange and I-80 are considered substandard for Federal highway designation due to inadequate width and design.

The major streets in the Meadowview/Pocket area of the city are Freeport Boulevard, 24th Street, Meadowview Road, and Florin Road. North-south freeway service is provided by I-5, immediately west of the community with access at Meadowview Road, Florin Road, and Blair Street/43rd Avenue. The major streets in the Pocket area are Florin Road,

Riverside Boulevard, Pocket Road, and 43rd Avenue. Secondary roads that provide important circulation include South Land Park Drive, Gloria Drive, and Greenhaven Drive. North-south freeway service is provided by I-5 with interchanges at Florin Road, Pocket/Meadowview, and 43rd Avenue. These roadways and their existing volumes are shown in figure 4-2.

Upper American River

The Auburn area is partially urbanized with heavy traffic volumes passing along I-80 and north to Grass Valley and Nevada City by way of Highway 49, which conveys about 7,000 vehicles daily through the study area (figure 4-3).

Access to the damsite is available from numerous dirt roads constructed to accommodate reconnaissance investigations for the previously authorized Bureau of Reclamation's Auburn Dam project. These roads are gated, unimproved, infrequently used, and carry correspondingly low traffic volumes.

Highway 49 descends and ascends the North Fork canyon by a slow, circuitous route. The highway is occasionally subject to closure by winter weather. Recreation-related traffic causes congestion in summer and winter.

The I-80/Foresthill interchange cannot handle the current recreation-related travel demand. Recognizing this, Placer County has included this interchange in its Regional Transportation Improvement Program for study by Caltrans and possible right-of-way purchase.

AIR QUALITY

This section addresses existing air pollution conditions in the study area and evaluates the region's conformance to applicable Federal and State air-quality standards.

Background

The Sacramento Valley air basin is in the northern portion of the Great Valley and extends into the neighboring mountain ranges. It is bounded on the west by the Coast Range and on the north and east by the Cascade and the Sierra Nevada Ranges. To the south is the San Joaquin Valley air basin. The Sacramento basin covers a region which, because of similar meteorological and geographical conditions, shares the same air and hence the same air pollution problems as the San Joaquin Valley basin. The concept of air basins recognizes that winds carry air pollutants throughout large areas and that topography and temperature inversions influence such transport. An air basin is not a precise physical division like a

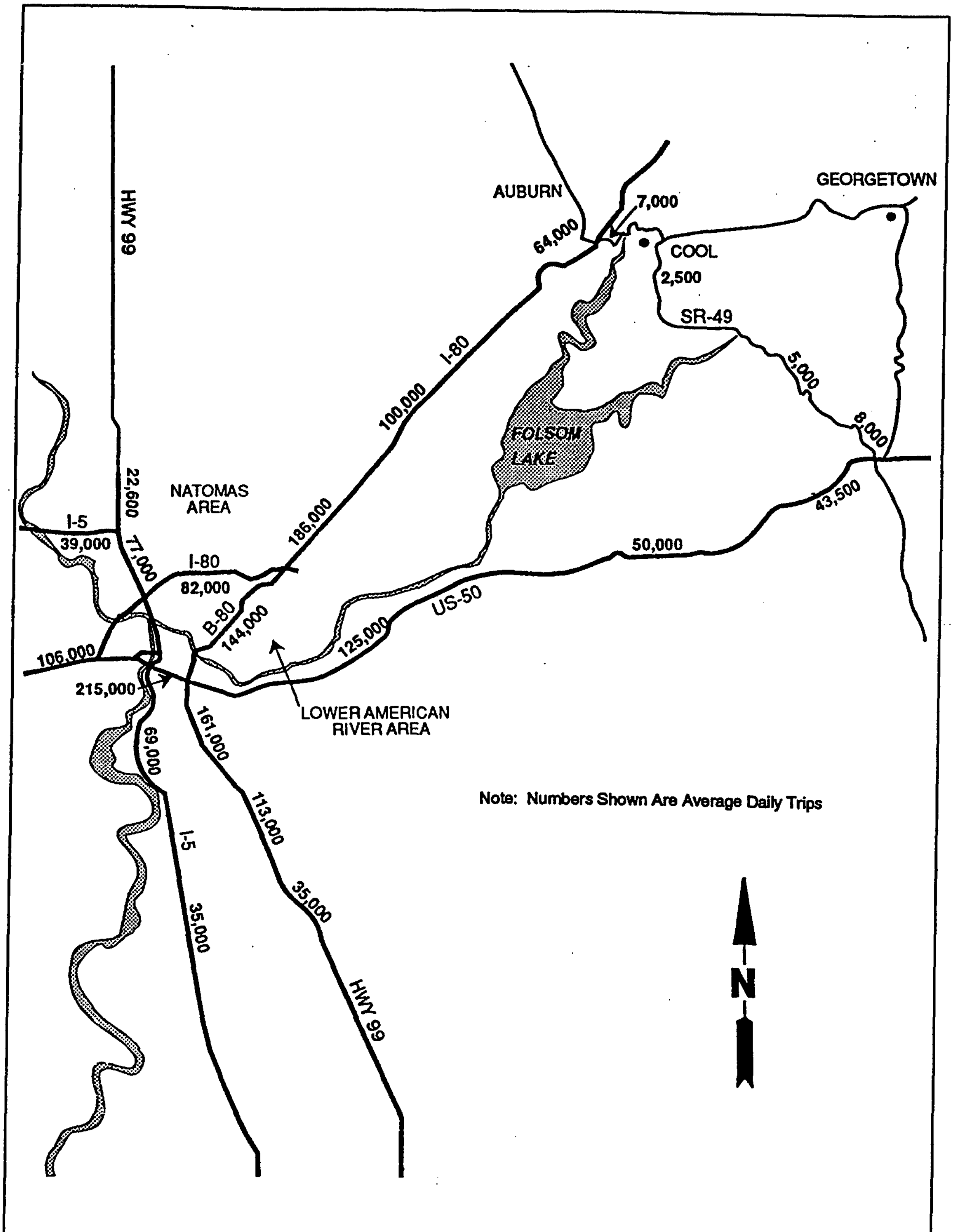
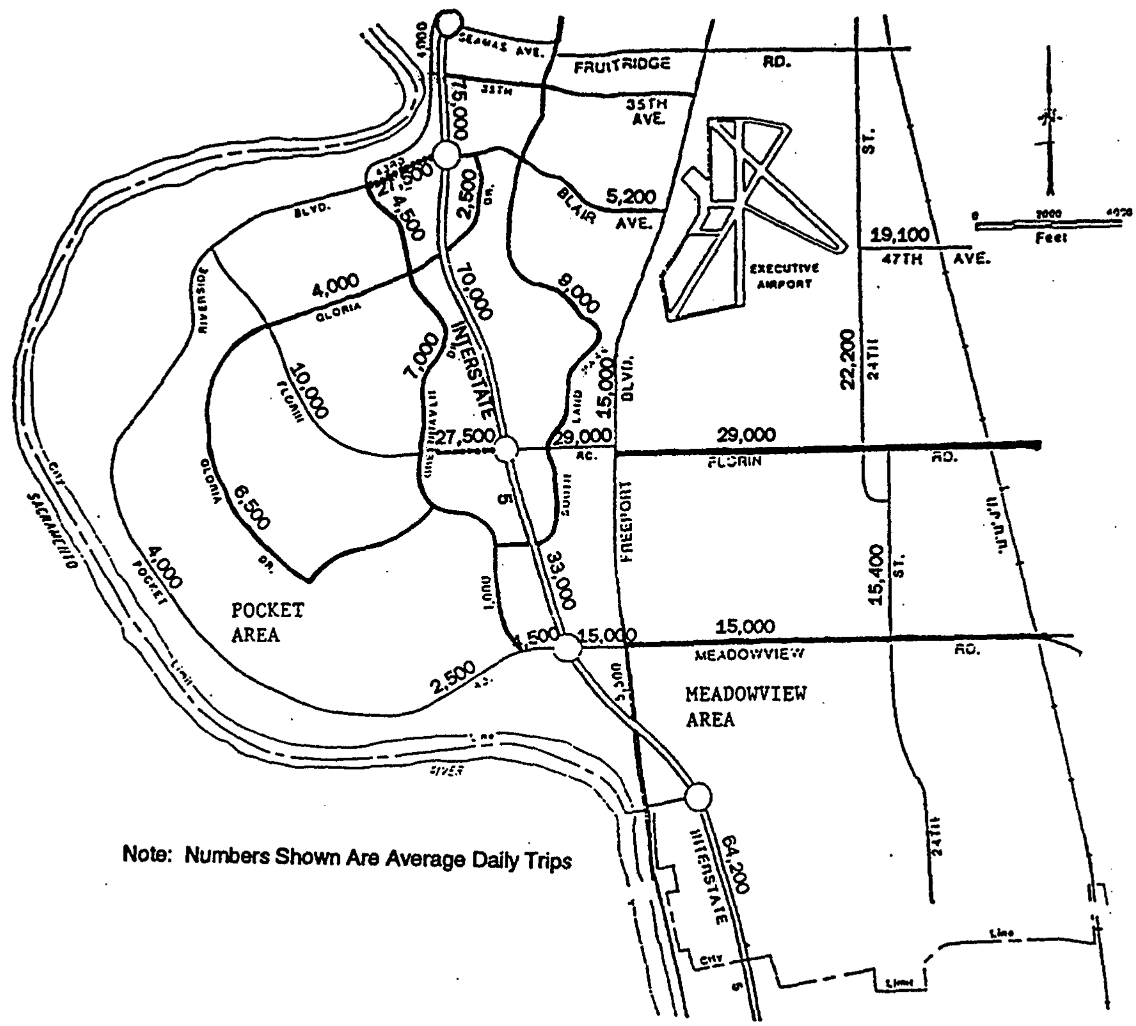


Figure 4-1. **Sacramento Regional Transportation Facilities in the Study Area and Existing Traffic Volumes.**



LEGEND

- Segments with V/C greater than 0.80 that cannot be mitigated without displacing existing uses
- Segments with V/C greater than 0.80 that can be mitigated to a less than siginificant level (none on this page)
- Segments with less-than-significant impacts

Figure 4-2. Pocket and Meadowview Existing Roadways and Traffic Volumes.

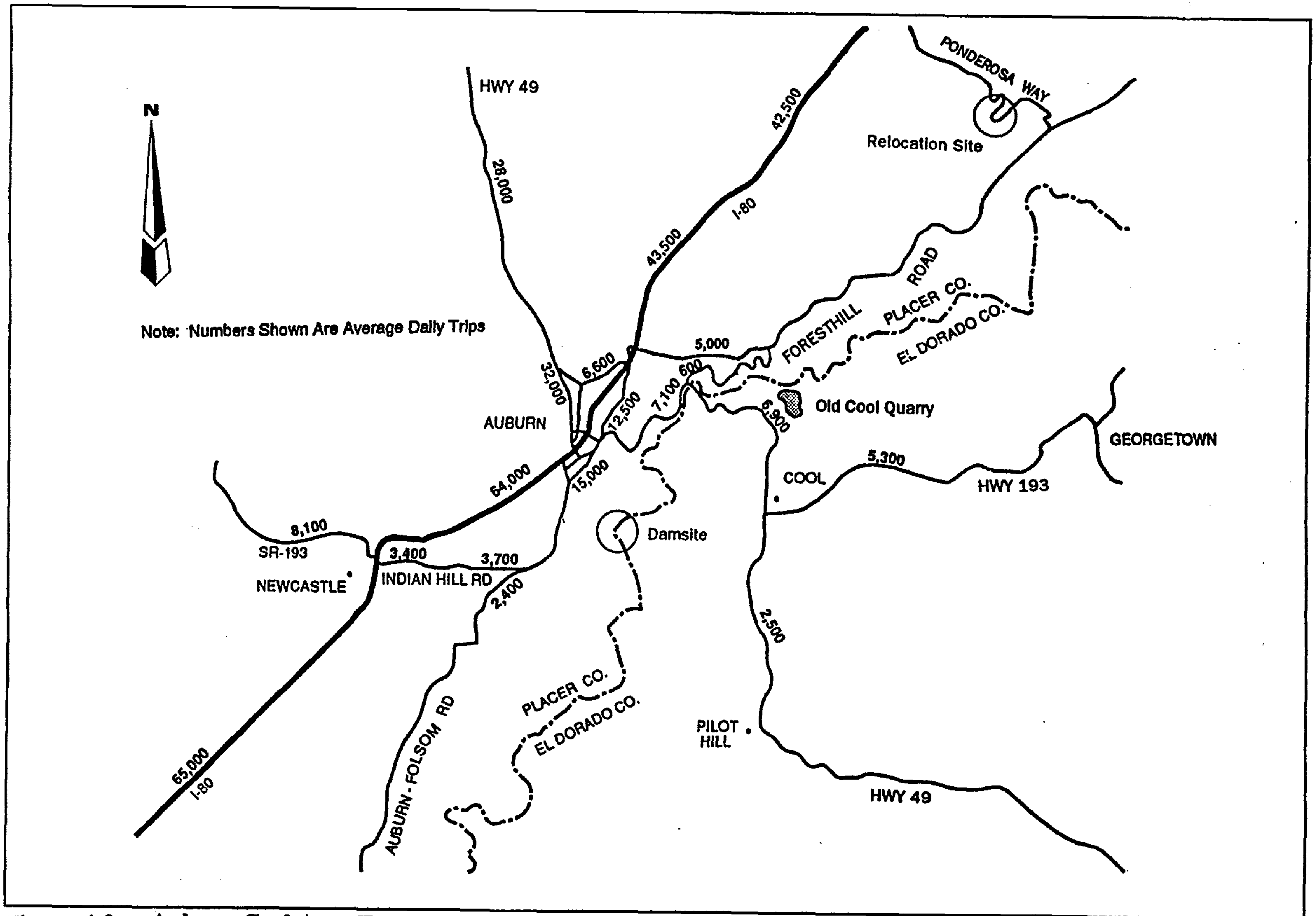


Figure 4-3. **Auburn-Cool Area Transportation Facilities & Existing Traffic Volumes.**

watershed, but a linkage of political districts established for dealing with air pollution that crosses municipal boundaries.

The principal air pollutant concern to the Sacramento basin is ozone, the main constituent of photochemical smog. Ozone is not released directly into the atmosphere; rather, it is a secondary pollutant resulting from a complex series of photochemical reactions. These reactions occur when precursor compounds, such as hydrocarbons and nitrogen oxides (NO_X), are mixed by light winds and heated by the sun. Hydrocarbon emissions represent a compound of reactive organic gases (ROG's), which result from evaporation of petroleum products.

Nitrogen oxide emissions result from combustion of petroleum products. ROG's and NO_X, measured in tons per day, are emitted into the air from a variety of sources. These sources are generally grouped into two main categories: stationary and mobile. Stationary sources consist of major industrial, manufacturing, and processing plants (point sources) and commercial/industrial facilities which individually emit only small quantities of pollutants but collectively result in significant emissions (area sources). Mobile sources consist of onroad motor vehicles, including automobiles, trucks, and buses, and offroad vehicles such as construction equipment, farm tractors, trains, ships, and aircraft.

The health effects of ozone include respiratory illnesses, chronic heart and lung disorders, and some anemias. Concentrations of ozone found regularly in various parts of the State can also harm normal, healthy adults. The effects often include nausea, headaches, eye irritation, dizziness, throat pain, breathing difficulty, and coughing. The health effects caused by combined concentrations of certain sulfur oxides and ozone are more severe than those caused by greater concentrations of either pollutant alone.

CO (carbon monoxide) is another, though less pervasive, pollutant emitted directly into the atmosphere and generally dispersed from the emission source and diluted through mixing. CO problems are usually localized and result from a combination of high traffic volumes and significant traffic congestion. CO pollution is most often a problem in winter months as a result of radiation inversion, which occurs when air near the ground cools in the evening while the air aloft remains warm.

The inversions, coupled with calm conditions, cause "hot spots" near the emission source due to poor dispersion during winter nights. These inversions usually burn off in the morning. CO levels are a public health concern because the CO molecule has a greater affinity to bind with hemoglobin than with oxygen (O_2) molecules, resulting in reduced oxygen in the blood. State and national standards were established to keep the carbon monoxide-hemoglobin concentration below levels that will harm cardiovascular and central nervous systems.

As mandated by the Clean Air Act of 1977 Amendments, the EPA (Environmental Protection Agency) established National Ambient Air Quality Standards for a variety of pollutants, including ozone and CO. These standards are designed to protect people most susceptible to respiratory distress, such as the acutely and/or chronically ill, young children, the elderly, and persons engaged in strenuous work. The Federal Clean Air Act requires each State to develop a State Implementation Plan detailing the pollution control measures necessary to attain the standards. Areas that do not meet these standards for any or all constituents are designated as "nonattainment" areas.

State air-quality standards have been established in California by the Air Resources Board (ARB). As indicated in table 4-6, these standards are generally more stringent than those established by EPA. Under the California Clean Air Act of 1988 (Sher bill), the ARB is required to establish criteria for identifying air basins which have not attained State air-quality standards. EPA has not adopted the State Implementation Plan submitted in November 1994 by the ARB. A Federal Executive Order suspended implementation of a Federal implementation plan in 1995. Construction activities would be coordinated with local air-quality management districts.

Lower American River

This project is in the south-central portion of the Sacramento basin. Yolo County, Sacramento County, southwest Placer county, and northern Solano County currently comprise the Sacramento Metropolitan Air Quality Maintenance Area. As depicted in figure 4-4, the Maintenance Area has been designated as a nonattainment area for ozone. In addition, a portion of the area lying within Sacramento County has been designated as a nonattainment area for carbon monoxide.

Upper American River

The western portion of this project area is in the Mountain Counties air basin, under the jurisdiction of the Placer County Air Pollution Control District. Although western Placer (just west of the City of Auburn) is within the boundaries of the Sacramento Maintenance Area, the project area proper is outside the Maintenance Area. All of Placer County, except that segment in the Lake Tahoe air basin, has been designated as a nonattainment area for ozone and unclassified for PM_{10}. EPA also has proposed to redesignate the county under the Federal Clean Air Act.

Because of the direction of prevailing air currents and the action of the Sierra Range as a climatological barrier, the Auburn area is subject to heavy influence from air contaminants originating in the Sacramento area, as well as from agricultural burning in the valley. Local industries and traffic on I-80 and Highway 49 also are significant sources of air pollution.

TABLE 4-6

Air Quality Standards

Pollutant	Averaging Time	California Standards[1]		National Standards[2]		
		Concentration[3]	Method[4]	Primary[3,5]	Secondary[3,4,6]	Method[7]
Ozone	1 Hour	0.09 ppm (180 µg/m3)	Ultraviolet Photometry	0.12 ppm (235 µg/m3)	Same as Primary Std.	Ethylene Chemiluminescence
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m3)	Nondispersive infrared Spectroscopy (NDIR)	9.0 ppm (10 mg/m3)		Nondispersive infrared Spectroscopy (NDIR)
	1 Hour	20 ppm (23 mg/m3)		35 ppm (40 mg/m3)		
Nitrogen Dioxide	Annual Average	---	Gas Phase Chemiluminescence	0.053 ppm (100 µg/m3)	Same as Primary Std.	Gas Phase Chemilumi- nescence
	1 Hour	0.25 ppm (470 µg/m3)		---		
Sulfur Dioxide	Annual Average	---	Ultraviolet Fluorescence	80 µg/m3 (0.03 ppm)	---	Pararosoaniline
	24 Hour	0.05 ppm[8] (131 µg/m3)		365 µg/m3 (0.14 ppm)	---	
	3 Hour	---		---	1300 µg/m3 (0.5 ppm)	
	1 Hour	0.25 ppm (655 µg/m3)		---	---	
Suspended Particulate Matter (PM_{10})	Annual Geometric Mean	30 µg/m3	Size Selective Inlet High Volume Sampler and Gravimetric Analysis	---	---	---
	24 Hour	50 µg/m3		150 µg/m3	Same as Primary Stds.	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	---	---	50 µg/m3		
Sulfates	24 Hour	25 µg/m3	Turbidimetric Barium Sulfate	---	---	---
Lead	30 Day Average	1.5 µg/m3	Atomic Absorption	---	---	Atomic Absorption
	Calendar Quarter	---		1.5 µg/m3	Same as Primary Std.	
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m3)	Cadmium Hydroxide Stractan	---	---	---
Vinyl Chloride (chloro- ethane)	24 Hour	0.010 ppm (26 µg/m3)	Tedlar Bag Collection, Gas Chromatography	---	---	---
Visibility Reducing Particles[9]	8 Hour (10 a.m.-6 p.m. PST)	In sufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particulates when the relative humidity is less than 70 percent. Measurement in accordance with ARB method V.		---	---	---

[FOOTNOTES ON NEXT PAGE]

NOTES:

[1] California standards for ozone, carbon monoxide, sulfur dioxide (1 hour), nitrogen dioxide, suspended particulate matter - PM_{10}, and visibility-reducing particulates are values not to be exceeded. The sulfur dioxide (24-hour), sulfates, lead, hydrogen sulfide, and vinyl chloride standards are not to be equaled or exceeded.

[2] National standards, other than ozone and those based on annual averages or annual arithmetic means, are not to be exceeded more than once a year. The ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentration above the standard is equal to or less than one.

[3] Concentration is expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25 °C and a reference pressure of 760 mm of mercury.

All measurements of air quality are to be corrected to a reference temperature of 25 °C and a reference pressure of 760 mm of mercury (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant permole of gas.

[4] Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air-quality standard may be used.

[5] National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health. Each State must attain the primary standards no later than 3 years after the State's implementation plan is approved by the EPA.

[6] National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each State must attain the secondary standards within a "reasonable time" after the implementation plan is approved by the EPA.

[7] Reference method as described by the EPA. An "equivalent method" of measurement may be used, but must have a "consistent relationship to the reference method" and must be approved by the EPA.

[8] At locations where the State standards for ozone and/or total suspended particulate matter are violated. National standards apply elsewhere.

[9] This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range when relative humidity is less than 70 percent.

Air contaminants are concentrated most often when the atmosphere is stable and winds are light for long periods of time.

NOISE

Background

Noise is often defined simply as unwanted sound, which is a subjective reaction to the characteristics of a physical phenomenon. The unit of sound-level measurement is the dB (decibel). A-weighted sound levels (expressed as dBA) are very well correlated with community reactions to noise and are used throughout this analysis unless otherwise indicated. Statistical descriptors such as the day-night average level (L_{dn}) represent variationsin sound levels over time. Figure 4-5 provides examples of sound levels associated with common noise sources.

Noise levels and impacts must be interpreted in relation to the noise standards and criteria applicable in each local jurisdiction affected by the project. The criteria applicable in this case are primarily for noise-sensitive residential uses and are intended to provide a suitable environment for indoor communication and sleep. Draft noise standards for Sacramento County establish maximum exterior sound levels of 50-70 dBA during the day and 45-65 dBA at night. Standards for the City of Sacramento and Placer and El Dorado Counties are 60 dB L_{dn}. Exterior noise exceeding this level is allowed only after detailed acoustical analysis of construction requirements and adoption of noise abatement features.

Lower American River

A 56.2 Leq ambient noise measurement was recorded in Natomas. Primary noise sources include traffic on the Garden Highway and aircraft from Sacramento Metropolitan Airport.

Noise at levee improvement sites in the lower American River area would be similar to noise reported for the urbanized areas of Natomas. The lower American River improvement sites are in the southwest end of the American River Parkway. Levees along the edge of the parkway have recreational uses on the waterside and commercial, industrial, and residential uses on the landside. This setting is similar to that described for the NEMDC south of I-80 in the Natomas area. Consequently, noise levels in the lower American River area are assumed to be similar to noise levels reported for the NEMDC; ambient background levels ranged from 51.1 to 61.6 dBA.

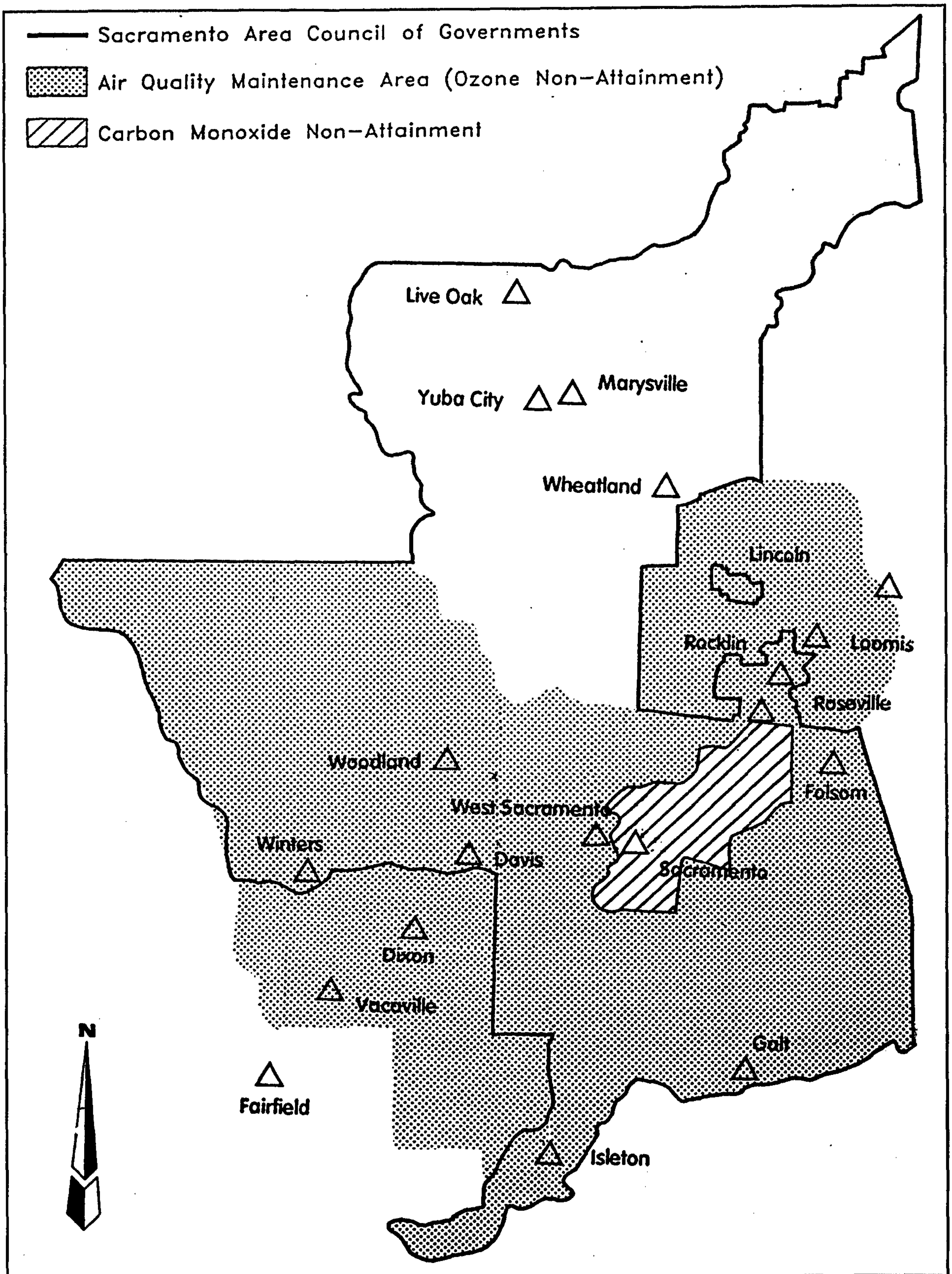
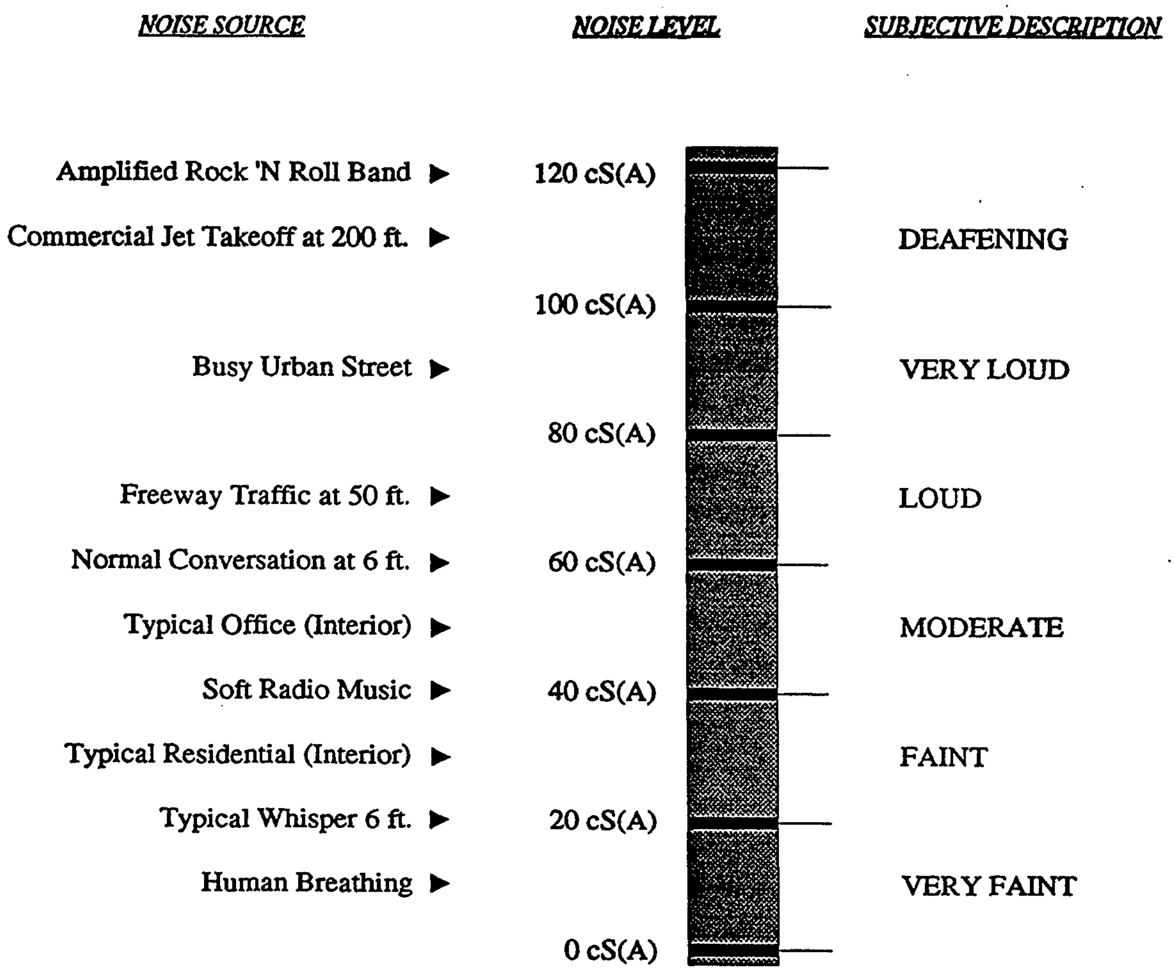


Figure 4-4. The Sacramento Air Quality Maintenance Area



Source: Architectural Acoustics, M. David Egan (1988)

Figure 4-5. Examples of Sound Levels Associated with Common Noise Sources.

Upper American River

Noise levels in El Dorado and Placer Counties where dam construction and Highway 49 replacement are proposed are also assumed to be relatively low. Noise levels in nearby communities are typical of low-density urban areas and are primarily traffic related.

VISUAL RESOURCES

An area's visual character is determined by the variety of the visual features, the quality of those features, and the scope and scale of the scene. The visual components of a particular area included landforms, vegetation, manmade structures, and land use patterns. The quality of these features depends on the relationship between them and their scale in the overall scene.

Visual analysis involves a degree of subjective evaluation based on the perception of the observer. Variety in a particular landscape and the relative value of the feature components will differ according to the perceptions of the individual observer. For example, areas with the greatest variety of features (steep slopes; large, sharp exposed ridges; varied vegetation; a large variety of water forms) are commonly considered to have the highest relative value among observers.

In assessing the visual resource impacts of a project, the visual sensitivity of the site must be considered. Areas of high visual sensitivity are those highly visible to the general public. Scenic highways, tourist routes, and recreation areas generate sensory reactions and evaluations by the observer. The evaluations of a particular scene will vary depending on the perceptions and values of the observer.

For analysis, the visual resources of the area covered by the project have been divided into the four subareas where the proposed action and alternatives would alter existing viewscapes: (1) lower American River, (2) Folsom Reservoir, (3) upper American River, and (4) downstream from American River.

Lower American River

The lower American River between Folsom Lake and the confluence with the Sacramento River flows through the core of the urbanized Sacramento area. Lake Natoma, immediately downstream from Folsom Dam, functions as a reregulating reservoir and is controlled by Nimbus Dam. High, steep natural banks confine the upper portions of the river, while the lower half (downstream from Goethe Park) is contained between levees. The river and its environs are natural in appearance and provide free-flowing water, gravel bars, deep pools, riparian forests, meadowlands, and parklands. (See figure 4-6.)

The American River Parkway, which runs 30 miles along this corridor from Discovery Park to Folsom Lake, is part of the State Wild and Scenic River System. It has "recreational" status under that system. Since most of the levees are set back from the river and vegetated with grasses and shrubs, few of the structural flood control features are visible to parkway users.

The vegetation within the American River corridor gradually changes from low foothill to valley floor species and represents a rich and diverse mosaic. The structure, composition, and successional stages are directly related to channel dynamics, topography, elevation, distance from the river, and frequency of inundation (Watson, 1985; Strahan, 1984).

The valley floor community is characterized by a diverse mix of exclusively deciduous trees including cottonwood, willow, valley oak, alder, box-elder, Oregon ash, and a few sycamore. Moving away from the river toward the uplands, the riparian forest typically gives way to woodland and grassland habitats. In the lower 12 miles of the American River Parkway, vegetation is confined to a narrow band between the river and the levees and comprises a significant visual feature. The vegetation in the upper 11 miles of the river occupies a broader expanse within the floodway. The variation of topography supports evergreen hardwoods such as canyon and interior live oaks and digger pine.

This variety of native plant communities greatly enhances the visual quality of the parkway and heightens the interest of parkway users in their natural surroundings. Because it is heavily used, the parkway is a visually sensitive resource; any degradation of the visual quality of the area will affect large numbers of parkway users.

The lower American River provides a variety of visual experiences, which include steep bluffs, terraces, islands, backwater areas, and riparian vegetation. The natural environment is a refreshing contrast to the urban development of the surrounding Sacramento areas.

The lower American River can be divided into three visual units: (1) from Nimbus Dam to the Gristmill Dam Recreation Area, approximately 2 miles upstream from the Watt Avenue Bridge; (2) from the Gristmill Dam Recreation Area to CSUS, just below the Howe Avenue Bridge; and (3) from CSUS to the confluence with the Sacramento River.

The first unit is the most visually interesting, has the greatest visual variety, and is considered to be the most sensitive visual unit. It is the area with the most water-oriented recreation visitor days, is viewed most by passing motorists at bridge crossings, and has the shallowest average water depth. The second unit has less visual variety than the upper section of the river, but it still maintains a fairly interesting viewscape. The area is commonly viewed by travelers over the Howe and Watt Avenue bridges and represents a well-known view. There are some riffles and ponds within the third unit, but artificial bank protection has degraded the visual attractiveness of the area. The visual corridor along the

river is still a fairly complex environment displaying variety both within the river and along the riverbank. Immediately above the mouth, the river's character changes. The river becomes slow moving, and the river substrate changes from cobble to sand.

Folsom Reservoir

Although it is not known for its esthetic appeal, this large manmade water body is a significant visual entity that contrasts sharply with the nearby foothill landscape and creates a vivid landscape. As summer progresses, the reservoir levels are drawn down an average of 24 feet, so a ring of bare soil is created along the water's edge. In dry years, this ring becomes a dominant negative visual feature that affects the visual quality of the area.

Folsom Reservoir, lying within a landscape of rolling wooded foothills, provides a pleasing visual setting for numerous recreational uses, especially when reservoir levels are high. However, during drawdown periods, the esthetic values of the reservoir are diminished by the denuded shoreline. Figure 4-7 shows the dam and reservoir.

Upper American River

The American River is one of the largest tributaries to the Sacramento River. Two of its three forks join the river above the proposed damsite, and the South Fork joins at Folsom Reservoir. The proposed damsite is on the North Fork, east of the city of Auburn.

This area is characterized by steep canyons covered with broadleaf and coniferous forests and chaparral vegetation. Steep terrain has deterred human development, thereby preserving the natural environment. These strong feature components create a bold landscape of high visual diversity and quality. (See figure 4-8.)

The Auburn Dam site is characterized by large grading cuts in the canyon walls, gravel excavation sites, and a network of dirt roads used for the construction of the former cofferdam. The construction zone significantly affects the natural integrity and visual quality of the canyon (figure 4-9). Although it is below the city of Auburn, the construction zone is not visible from Auburn.

Downstream from American River

The Sacramento River flows through the core of the urbanized Sacramento area. The stretch of the river which could potentially be affected under the plans presented in this report is from Verona to the confluence with the American River. The visual resource values of the Sacramento River system are varied and represent a complex setting of geographic landscapes, vegetative communities, and open and confined waterways. The river below Verona and throughout the project area is subject to intensive levee management. The system can provide a quality visual experience for those who visit the banks of the river and its sloughs. This quality is enjoyed by those who go to enjoy the natural beauty, those

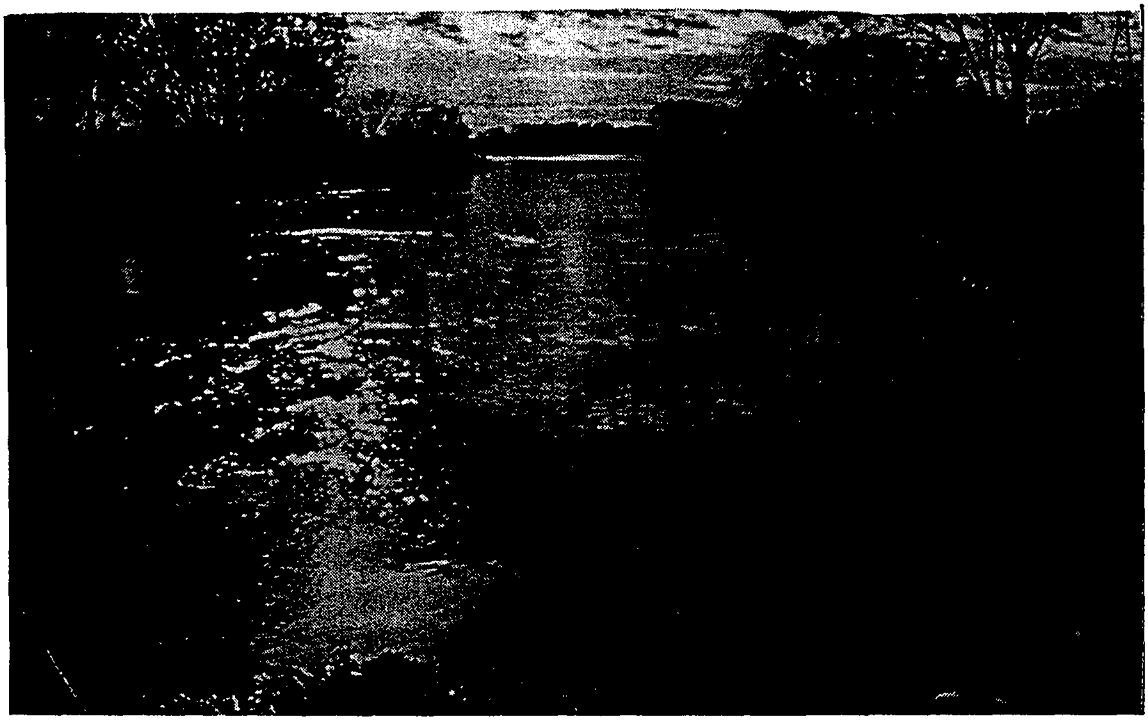


Figure 4-6. View of the Lower American River

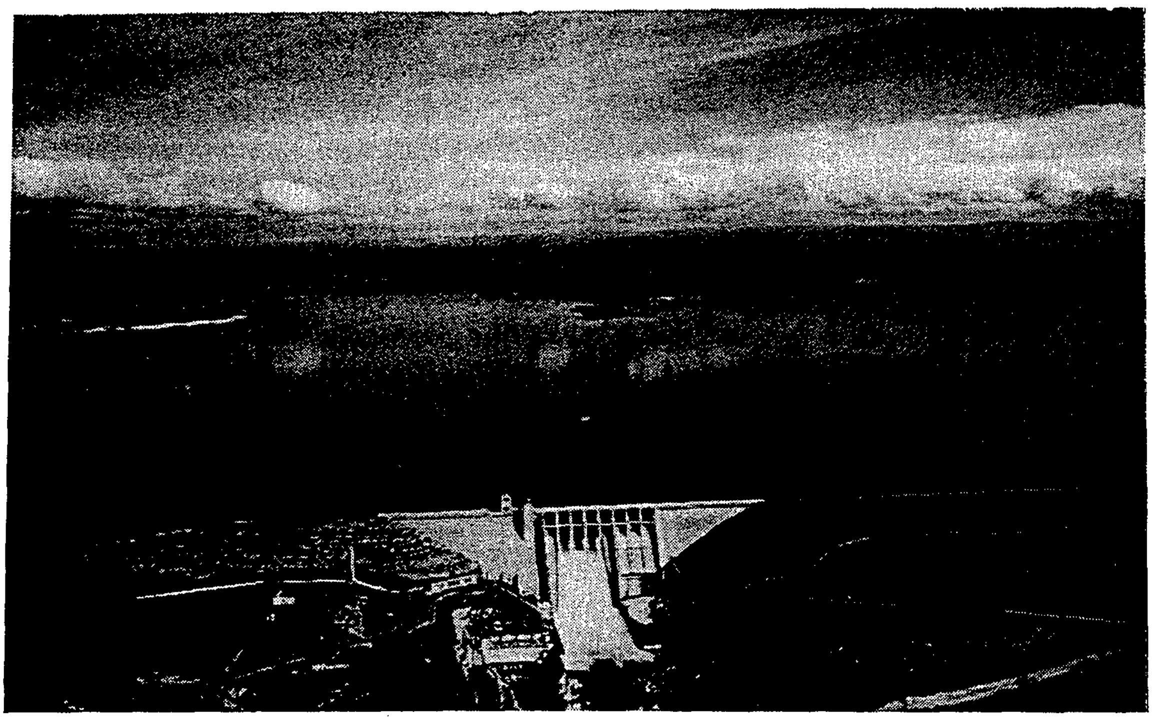


Figure 4-7. Folsom Lake and Dam.

Figure 4-8. View of the Middle Fork American River.

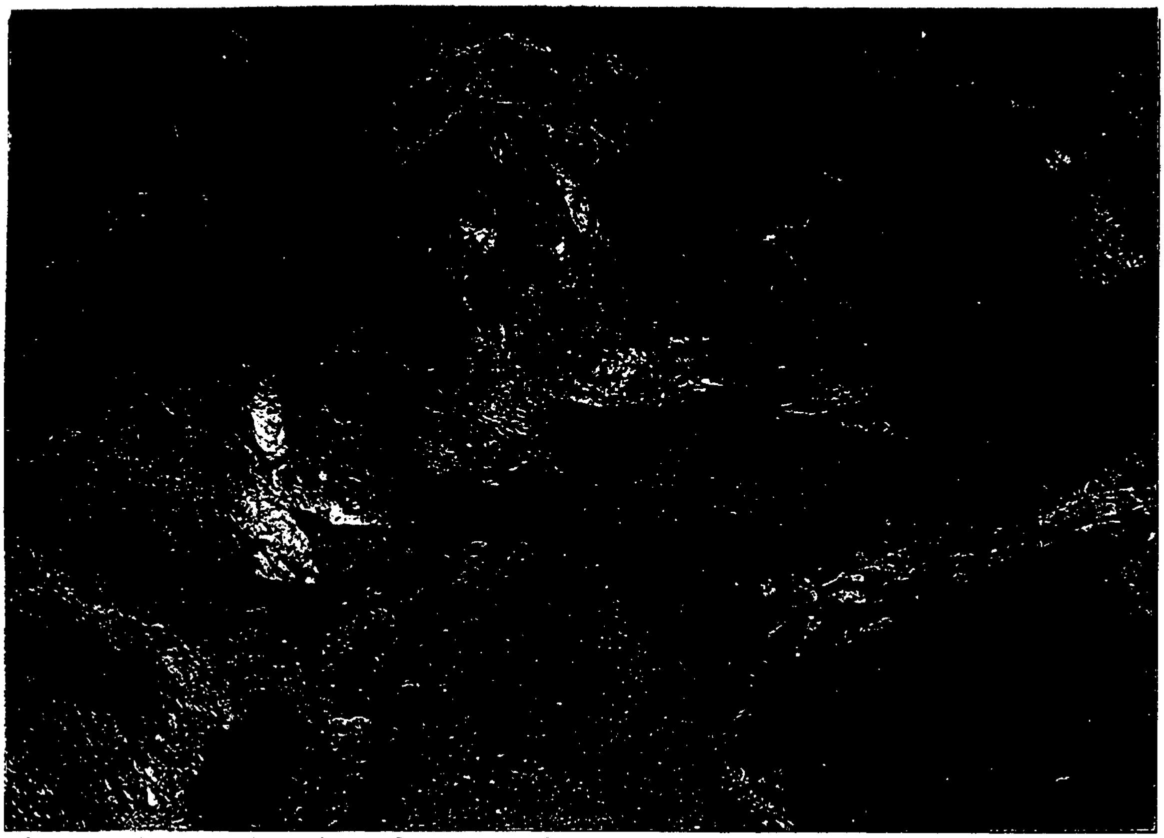


Figure 4-9. Aerial View of the Damsite Area.

who go for recreational reasons, and those on their way to another destination. (Figure 4-10 shows Lindsey Slough, which is typical of areas downstream.)

INDIAN TRUST ASSETS

Indian Trust Assets are legal interests in assets held in trust by the Federal Government for Indian tribes or individual Indians. There is not a comprehensive listing of these assets for tribes and individual Indians, although there may be such listings for some tribes (Reclamation, 1994). The Office of American Indian Trust plans to compile inventory listings of all assets for all tribes, but as of February 1994 lacked funding to begin this effort.

Recent conversations with Reclamation consultants conducting the survey and analyses of Indian Trust Assets for the programmatic EIS for Title 34 of Public Law 102-575 indicate that the best information identifying assets is very general with respect to the land areas covered. Specific assets have not yet been identified for the project area (R. Smith, pers. comm., 1994).

Figure 4-10. Typical view of the Hydraulic Mitigation Area (Lindsey Slough).

WILD AND SCENIC RIVER STATUS

Lower American River

The American River from Nimbus Dam to its confluence with the Sacramento River is designated a component of the California Wild and Scenic Rivers system (PRC section 5093.54 subd [e]), and also is classified as recreational (PRC section 5093.545 subd [h]. Section 5093.56 of the California Wild and Scenic Rivers Act states that:

> "No department or agency of the state shall assist or cooperate, whether by loan, grant, license, or otherwise, with any department of the Federal, State, or local government, in the planning or construction of any dam, reservoir, diversion, or other water impoundment facility that could have an adverse effect on the free-flowing condition and natural character of the river and segments thereof designated in Section 5093.54 as included in the system . . . ."

In January 1981, the Department of the Interior designated the lower reaches of the American River as a component of the National Wild and Scenic Rivers System. It was designated as a recreational river to acknowledge its unique urban recreational opportunities. The Wild and Scenic Rivers Act prohibits Federal agencies from constructing, assisting with, or licensing water resources projects which would adversely affect the values for which the river segment was included in the system. Federal land management agencies are to reassess management policies, plans, regulations, and contracts on lands adjacent to designated segments for their conformance with the protection purposes of the act.

Upper American River

In September 1992, Reclamation completed the technical team inventory and recommendation phase of the Wild and Scenic River Eligibility and Preliminary Classification study conducted for its American River Water Resources Investigation. This study evaluated the Middle Fork American River from the confluence to Oxbow Dam, the North Fork from the Colfax-Iowa Hill Bridge to the upper end of Lake Clementine, and from the North Fork Debris Dam to the intake of the diversion tunnel. For a river or a section of a river to be eligible for wild and scenic status, it must be determined to be "outstandingly remarkable" based upon one or more of the following criteria: scenic, recreational, geological, fish and wildlife, historical, cultural, and ecological values.

The study concluded that the North and Middle Forks of the American River are unique river segments in several ways containing at least one "outstandingly remarkable value" in each of the reaches. This finding was based on the analysis of eight resource categories by representatives from several Federal and State resource agencies. This finding will be processed and submitted to Congress. The Regional Director of the Bureau of Reclamation has concurred with this including. This finding will examine the technical, economic, and practical aspects of including these segments of the American River into the Wild and Scenic Rivers System.

The BLM (Bureau of Land Management) was authorized by Congress in 1989 to undertake a study of the American River watershed ". . . for the purpose of determining the feasibility and desirability of designating a National Recreation Area within the American River watershed in association with a flood control or multipurpose dam located at or near the site of the Auburn Dam." The BLM determined that the American River watershed fully meets all the National Recreation Area eligibility criteria of being sufficiently spacious, having an abundance of outstanding natural and cultural features, offering a wide variety of recreation opportunities, and being adjacent to a fast-growing metropolitan area of more than a million people. The BLM, however, was unable to draw any conclusions regarding desirability and recommended that the issue be readdressed once the issue of the dam is resolved.

CHAPTER 5

PROCEDURES USED TO DETERMINE ENVIRONMENTAL CONSEQUENCES

The environmental and socioeconomic consequences of the alternatives are evaluated in chapters 6 through 9. For each alternative, four general categories of impacts are identified: operational impacts, construction impacts, cumulative impacts, and growth-inducing impacts. These categories and the approach used to evaluate the identified impacts are explained below. The purpose of this chapter is to define the impact categories, discuss the methods used to assess impacts, and identify mitigation and environmental monitoring concepts.

OPERATIONAL IMPACTS

All the alternatives carried forward for detailed analysis, including the No-Action Alternative, would result in "operational" impacts, defined as the socioeconomic and environmental consequences of modifying the existing flood control system to provide increased flood protection to Sacramento. These impacts are associated with (1) changes in the operation of Folsom Reservoir and the other CVP facilities north of the Delta to accommodate an increase in the space allocated to flood control at Folsom; (2) changes in the design and operation of the American River and Sacramento River levee systems to accommodate higher objective releases from Folsom Dam; and (3) changes in the geomorphology of the American River canyons resulting from the operation of a flood detention dam at the Auburn site.

CHANGES IN CVP OPERATIONS

Under the No-Action Alternative, the 1995 agreement (Agreement) between SAFCA and Reclamation, which has secured a temporary increase in the space allocated to flood control in Folsom Reservoir, would be indefinitely extended. For purposes of this final SEIS/EIR, it is assumed that by virtue of this extension, the operation of Folsom Reservoir and the other CVP facilities north of the Delta would be permanently modified, as necessary, to meet the requirements of the flood control diagram (1993 Diagram) contained in the Agreement. Two conditions were evaluated to determine the socioeconomic and environmental consequences of these operational modifications. The "Baseline Condition Scenario" assumes that as of October 31, 1999, the termination date of the Agreement,

Folsom would revert to operation in accordance with the Corps' 1986 flood control diagram (1986 Diagram). Under this condition, the recreational improvements and temperature control shutters installed at Folsom Dam required under the Agreement remain in place, and CVP operations are adjusted to reflect reasonably foreseeable water demands for consumptive use and environmental needs through 2020. The No-Action ("permanent reoperation") scenario incorporates these demand assumptions, but adjusts CVP operations to comply with the 1993 Diagram. The No-Action Alternative is in turn used as the basis for evaluating (1) the adverse operational impacts associated with permanently increasing the amount of fixed storage space allocated to flood control as proposed under the Folsom Modification Plan and (2) the positive impacts of reverting Folsom Reservoir operations to the 1986 Diagram as proposed under the Detention Dam Plan.

CHANGES IN THE DESIGN OF DOWNSTREAM LEVEE SYSTEMS

The Stepped Release Plan includes measures designed to improve the efficiency of flood control operations at Folsom and increase the conveyance capacity of the levee system for the lower American River and lower Sacramento River. Under this plan, the design release from Folsom Dam would be increased from 115,000 cfs to a maximum of 180,000 cfs. This plan would thus alter the flows in the American River channel, which local city and county interior drainage facilities and other infrastructure in the American River flood plain were designed to accommodate, and increase the flows in the lower reaches of the SRFCP beyond the current design of that system. The Stepped Release Plan includes measures intended to eliminate any adverse impacts to the interior drainage facilities that could result from these operational changes. The proposed measures are designed to ensure that the affected levees, infrastructure, and drainage facilities perform as reliably under the conditions created by the Stepped Release Plan as under the conditions under the No-Action Alternative.

CHANGES IN THE GEOMORPHOLOGY OF THE AMERICAN RIVER CANYONS

Operation of the flood detention dam proposed under the Detention Dam Plan would significantly alter the geomorphology of the American River canyons upstream from the damsite. Two types of impacts could result: (1) loss of vegetation and related wildlife mortality due to periodic inundation and (2) destruction of environmental and recreational resources due to damage to the trail system from saturated soils along the canyon walls within the inundation zone. The potential for inundation mortality was measured by preparing an inventory of the plant species presently occupying the inundation zone, assessing the flood tolerance of these species, and modeling the frequency and depth of flooding likely as a result of the project.

CONSTRUCTION IMPACTS

Construction of each of the action alternatives would commence in the year 2000, and all work would be completed 9 years later. The construction process would result in a number of significant short-term impacts on existing resources in the areas where construction would take place. Depending on the alternative, these impacts include the impacts associated with structurally modifying Folsom Dam, the impacts associated with modifying the downstream levee system, and the impacts associated with constructing a flood detention dam at Auburn.

FOLSOM DAM MODIFICATIONS

This group includes the construction impacts resulting from lowering the Folsom Dam spillway, enlarging the eight river outlets through the main dam, and modifying the auxiliary spillway gates and selected dam embankments to permit increased surcharge storage. These impacts will be discussed primarily in connection with the Folsom Modification Plan. With minor exceptions, noted in the text, these same structural modifications are included in the Stepped Release Plan.

DOWNSTREAM LEVEE IMPROVEMENTS

This group includes the impacts resulting from raising and strengthening portions of the lower American River levee system to carry increased objective releases from Folsom; modifying interior drainage facilities, bridges, and other infrastructure to accommodate the higher flows; lengthening the Sacramento Weir and widening the Sacramento Bypass to ensure that the increase in American River flows is conveyed to the Yolo Bypass and does not increase flood stages in the Sacramento River downstream from the confluence; raising and strengthening levees in the Yolo Bypass to ensure that the risk of flooding on adjacent lands in Yolo and Solano Counties is not worsened; and raising and strengthening a portion of the east levee of the Sacramento River downstream from the mouth of the Natomas Cross Canal to ensure that the lands within the Natomas basin are protected to the same level as the lands in the American River flood plain outside Natomas.

These would be the impacts associated with strengthening levees of the American and Sacramento Rivers and would occur under all alternatives carried forward for detailed analysis, including the Detention Dam Plan. These impacts will be discussed in connection with the Folsom Modification Plan. The impacts associated with raising the American River levees, redesigning the infrastructure in the American River Parkway, and increasing the

conveyance capacity of the bypass system will be discussed primarily in connection with the Stepped Release Plan.

DETENTION DAM CONSTRUCTION

In addition to the levee strengthening listed above, this group includes all the impacts associated with constructing a flood detention dam near Auburn and relocating Highway 49, as proposed under the Detention Dam Plan.

CUMULATIVE IMPACTS

Cumulative impacts are those which result from the incremental impact of any given action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or individual undertakes such other actions. These impacts are briefly discussed below.

IMPACTS TO THE CVP

The cumulative socioeconomic and environmental effects of adding permanent reoperation to other reasonably foreseeable demands on the CVP are accounted for in the scenario's developed to measure the differences between operating Folsom Reservoir under the 1993 Diagram (No-Action Alternative) versus the 1986 Diagram (Baseline). The scenario's treat reasonably foreseeable demands as constants to identify the relative difference in (cumulative) impacts between the two operations. The Folsom Modification Plan is evaluated to determine the extent to which this difference in cumulative impacts would be increased by expanding the space allocated to flood control in Folsom Reservoir. The detailed discussions of converting from the Baseline condition to the future with-project condition are contained in chapter 10.

IMPACTS TO WETLAND AND RIPARIAN RESOURCES

Construction of levee improvements anticipated under the Stepped Release Plan would result in unavoidable impacts to wetland and riparian habitat, for which mitigation would be required. For wetlands, the requirements of Executive Order 11990 dictate no net loss of wetlands, and as such wetland losses would be fully replaced. For riparian losses, mitigation would seek to replace lost habitat value. These unavoidable, but mitigated, losses will be added to other losses of similar habitat along the Sacramento River Flood Control Project

resulting from ongoing levee and bank improvement projects to estimate the rate at which wetlands and riparian habitat are being affected on a cumulative basis and to evaluate the relative success of the various mitigation and restoration efforts to offset these effects.

GROWTH-INDUCING IMPACTS

Growth-inducing impacts are those that result indirectly from growth facilitated by the project. Although the project will have a negligible effect on long-term regional growth, provision for a 100-year level of flood protection to the lands within the American River flood plain under the No-Action Alternative would enable development which might otherwise locate outside the flood plain to proceed as planned on about 1,200 acres in the Meadowview Community Plan area of the City of Sacramento. The resulting locational impacts in the Meadowview area are evaluated in chapter 10 in connection with the No-Action Alternative.

None of the proposed action alternatives would induce flood plain development, since the magnitude of such development would be the same under each of these alternatives as under the No-Action Alternative. The fundamental conditions necessary to remap the 100-year flood plain in Sacramento, clearing the way for development, would be fulfilled by actions undertaken either in advance of the alternatives studied in the SEIS/EIR or in lieu of these alternatives. These actions include (1) stabilization of the east levee of the Sacramento River, completed in 1993; (2) improvement of the levees around the Natomas basin and in portions of the lower Dry and Arcade Creek watershed which is being carried out with local funding by SAFCA and will be completed by the end of 1996; and (3) indefinite extension of SAFCA's agreement with Reclamation which would take place if Congress fails to take action on any of the alternatives evaluated in the SEIS/SIR.

Since the remapping of the 100-year flood plain in Sacramento would permit the City to proceed with land uses contemplated in its current general plan, the impacts associated with such development are evaluated in (1) the final environmental impact report which the City certified in 1988 in connection with its adoption of the current plan and (2) the series of more focused supplemental environmental documents issued by the City. Additional analysis of flood plain development impacts may be found in (1) the final EIS/EIR issued by the Corps of Engineers and The Reclamation Board in connection with the American River Watershed Investigation in 1992, (2) the final EIR and related supplemental environmental documents issued by SAFCA in connection with the Natomas Area Flood Control Improvement project, and (3) the final EIR for Interim Reoperation of Folsom Dam and Reservoir.

MITIGATION AND ENVIRONMENTAL MONITORING

This section discusses the mitigation monitoring plans which will be developed to ensure that the mitigation measures identified in chapters 7, 8, and 9 and summarized in chapter 1 (Summary) will be accomplished. These mitigation measures consist of habitat preservation, restoration, or improvement and other actions required to minimize or compensate for unavoidable impacts of the proposed alternatives. In accordance with Section 906 of the Water Resources Development Act of 1986 and Section 8611 of the California Water Code, mitigation for direct project impacts, including land acquisition and vegetative plantings, will be accomplished prior to or concurrent with project construction. This mitigation will be an authorized project feature and will be cost shared by the Federal Government and the project's non-Federal sponsor.

The goal of mitigation features of this project is to create habitat values which will be equal to or greater than those for the various sites affected by the project construction. Proposed mitigation measures are presented in the mitigation section for each alternative and are described more thoroughly in appendix H.

Specific and detailed mitigation monitoring plans will be developed after project authorization. A final mitigation and monitoring program will be completed during the project design phase, and the appropriate jurisdictional agencies will have the opportunity to review the proposed project and mitigation measures and provide guidance relative to the monitoring of those measures. The final mitigation monitoring plan will be completed and presented for approval when the State Lead Agency adopts findings as required by the California Environmental Quality Act.

FEDERAL REQUIREMENTS

To ensure that mitigation for direct project impacts is accomplished, a mitigation monitoring plan will be prepared by the District Engineer in consultation with the non-Federal sponsors and appropriate resource agencies. The plan will define appropriate mitigation monitoring criteria and outline the methods needed to ensure that these criteria are fulfilled.

STATE REQUIREMENTS

Pursuant to the California Environmental Quality Act, Public Resources Code 21081.6, public agencies shall adopt a reporting or monitoring program for the mitigation measures identified as necessary to mitigate or avoid significant effects to the environment.

In addition, the California Water Code section 8611 requires The Reclamation Board to prepare a mitigation plan in consultation with the Department of Fish and Game prior to construction of a flood control, channel clearance, or bank stabilization project. This plan must contain:

- A description of actions to be taken to ensure that the project meets all mitigation requirements required by law and causes no net loss of riparian, fishery, or wildlife habitat.
- A designation of the agency or agencies responsible for implementing and maintaining each element of the mitigation plan.
- A schedule of mitigation implementation, ensuring that the mitigation measures would be accomplished prior to or concurrent with construction of the project, unless The Reclamation Board determines that to do so would be impracticable.
- A financing plan, identifying the sources of funds, the share of mitigation costs attributable to each source, and schedule of when the funds are to be provided.

MITIGATION FOR PROJECT IMPACTS

To the extent feasible, FWS guidance will be followed relative to the sequential preference of mitigation options. These mitigation steps in order of preference are:

1. Avoidance of Impacts
2. Minimization of Impacts
3. Rectification of Impacts
4. Reduction or Elimination of Impacts Over Time
5. Compensation for Impacts

All adverse environmental impacts will be avoided or minimized to the greatest extent possible.

Mitigation for impacts to local drainage and water quality, air quality, traffic patterns, and noise resulting from construction will generally be accomplished through avoidance by requiring contractors to adhere to appropriate standards for operating heavy equipment, complying with local regulations and standards for air-quality attainment, submitting spill containment plans for handling petroleum products and hazardous materials, conforming to applicable local standards for operating equipment on public roadways, properly disposing of trash and refuse generated by construction activities and workers, and constructing such facilities required to prevent sediment from being introduced into the aquatic environment as a result of construction activities. These requirements will be included in the plans and specifications of the construction contracts issued in connection with the project.

Impacts to upland and grasslands as a result of construction will be rectified onsite. For replacement of grasslands, the construction contractor will monitor and guarantee the survival of all grass-seeded areas for 6 months. Successful seeding will result in at least 50 percent cover of the seeded site, or 50 percent germination and survival of planted seeds. Seeded areas which fail to germinate or are otherwise damaged may be replaced until March 1. After this date, areas where plants must be replaced will be reseeded the following fall between September 1 and December 1 in accordance with the original seeding plan.

In general, where adverse environmental impacts cannot be avoided and offsite mitigation would be necessary to compensate for these impacts, the mitigation contractor will maintain and monitor mitigation areas for 3 years after installation of plantings. All plantings will receive watering, weed control, protection from predation, and replacement of dead and dying trees during the establishment period. Watering and maintenance will be required for a period of 3 years or until the plants are self-sufficient and capable of self-regeneration. Monitoring during this period will be coordinated with FWS and DFG.

PERFORMANCE CRITERIA, REMEDIATION, AND DOCUMENTATION

The mitigation monitoring plan will contain specific measures and performance criteria to ensure that impacts to wildlife habitat are mitigated as planned and that adequate habitat values result from mitigation efforts. The Corps will lead a monitoring team consisting of members from the appropriate resource agencies and the non-Federal sponsor. The team will monitor all mitigation areas annually for years 4 through 10, and then every 5 years until the project has met or exceeded success criteria. For years zero through 3, mitigation areas will be monitored by the mitigation contractor in coordination with the Corps, non-Federal sponsor, and jurisdictional agencies.

Failure to meet performance criteria for any component of the mitigation plan, such as the losses or damage to trees planted for mitigation, will require replacing or restoring plants or trees in accordance with the Operation and Maintenance manual which will be developed in accordance with the mitigation objectives for the project. These recommendations will be included in the annual monitoring report.

FEDERAL PARTICIPATION IN PERMANENT REOPERATION OF FOLSOM RESERVOIR

Implementation of the temporary agreement between SAFCA and Reclamation to change the operation of Folsom Reservoir from the Baseline condition of 400,000 acre-feet of fixed flood storage reservation to a flexible storage reservation of between 400,000 and 670,000 acre-feet has resulted in impacts to several resource categories. SAFCA has provided mitigation for the impacts which would result from the 5-year period of the agreement. The 400,000 and 670,000 acre-foot operation is the No-Action Alternative to which the action alternatives are compared for determining project impacts and mitigation requirements.

However, this results in breaking the impacts of changing the operation from 400,000 to 400,000/670,000 acre-feet for No-Action, or to 475,000/720,000 acre-feet of storage for the Folsom Modification Plan into smaller increments, none of which are significant. The impacts from permanently reoperating Folsom Reservoir using the rule curve have been identified and evaluated and are discussed in chapter 6 for the No-Action Alternative (the impact discussion also covers the reoperation component of the Stepped Release Plan, since reoperation under this plan is the same) and chapter 7 for the Folsom Modification Plan.

Should the Federal Government authorize a project which includes a permanent reoperation component, mitigation would likely be provided for the impacts of changing from the Baseline condition of 400,000 acre-feet of fixed storage to the Stepped Release Plan (400,000 to 670,000 acre-feet) or the Folsom Modification Plan (475,000 to 720,000 acre-feet) as these would be the impacts for which mitigation would be provided should either plan become the authorized Federal project. Further information on including permanent reoperation as part of the Federal project is contained in chapter 10.

CHAPTER 6

ENVIRONMENTAL CONSEQUENCES
NO-ACTION ALTERNATIVE

It is anticipated under the No-Action Alternative in the absence of any congressional action to improve the existing American River flood control system, the Interim Reoperation Agreement between SAFCA and Reclamation, which has secured a temporary increase in the space allocated to flood control in Folsom Reservoir, would be indefinitely extended. By virtue of this extension, the operation of Folsom Reservoir and the other CVP facilities north of the Delta would be modified, as necessary, to meet the requirements of the flood control diagram (1993 Diagram) referenced in the Agreement. The No-Action Alternative serves as the baseline against which alternatives are compared to determine the impacts and mitigation requirements. Since no construction would be required to implement this plan, the discussion focuses on the operational impacts associated with adjusting CVP operations to accommodate the requirements of the 1993 Diagram.

The potential effects of a permanent reoperation are discussed in chapter 10. The primary topics described are the likely socioeconomic and environmental effects and required mitigation of changing the flood control operation at Folsom Dam from a fixed 400,000 acre-feet of storage to the permanent reoperation.

OPERATIONAL IMPACTS

The following operational impact analysis is based on (1) information contained in the "Interim Reoperation of Folsom Dam and Reservoir Final Environmental Impact Report Environmental Assessment," prepared jointly by SAFCA and Reclamation, (2) "Folsom Dam and Reservoir Permanent Reoperation" (Montgomery Watson, 1995), and (3) supporting model data.

METHODOLOGY

The PROSIM (PROject SIMulation) model was used to evaluate the impacts of modifying the flood control space in Folsom Reservoir. The model was developed by Reclamation to evaluate the effects of operating the CVP/SWP under various hydrologic conditions. The model takes into account storage in the various reservoirs, water demands for a variety of needs at various locations, including minimum flow standards and basic hydrologic parameters under various water-year conditions. Basic output from the model includes end-of-period reservoir storage, deliveries to users, and streamflow at various points. From this information, estimates of water deliveries, reservoir storage, hydropower

capacities, and water temperatures can be estimated for a variety of different conditions. The PROSIM model simulates conditions by the mass balance approach on a monthly time step over a specified data period, in this case 70 years (1922 through 1991). For purposes of this evaluation, it was assumed that:

(1) the 70-year hydrologic record (1922 through 1991) used by Reclamation and others for water planning in California represents the best information available for projecting impacts to hydrologic or hydrologically dependent resources. This period includes periods of extended drought, periods of high runoff, and variation between. To model operations as they exist today, demands for each of the study years from 1922 through 1991 were estimated based on a common level of population, acreage development, and land use. These estimated demands enable the CVP (and SWP) operations to be evaluated as if past hydrologic conditions were to recur.

(2) the operation of the three largest non-Federal reservoirs in the American River watershed (French Meadows, Hell Hole, and Union Valley) would remain unchanged for purposes of the analysis. The model studies assume that these reservoirs will continue to be used primarily as hydropower facilities to provide almost instantly available capacity and energy for northern California utilities. Reservoir storage is evacuated during the summer and fall in all three reservoirs. This vacant space is usually filled during the winter and spring because of the nature of hydrologic conditions in California. Along with consumptive water deliveries, power operations during the peak electricity demand months of the summer constantly call on the water stored in these reservoirs. By late fall, these demands lead simultaneously to a considerable reduction in water storage and a considerable increase in the space available for incidental flood control. As the demand for water and power increases over time, it is assumed that this historical pattern of operation will continue.

(3) the operation of the CVP would reflect 2020 hydrology and demands.

Important input assumptions used in the model include hydrology and a host of system constraints. Hydrology includes recorded and simulated gains (inflows) or losses (evaporation, for example) to system reservoirs and gains or losses to the streams. It also includes system demands under current and future (2020) conditions. These assumptions include:

- Use of December 1994 Bay/Delta standards in place of January 1994 EPA standards. Also, excluded from the analysis were D-1485 standards and NMFS February 1993 winter-run chinook salmon and FWS February 1994 Delta smelt biological opinions. However, it may be said that December 1994 Bay/Delta standards purport to reflect the provisions of the aforementioned standards reached through a consensus among agricultural, municipal and industrial, and environmental interests. The December

1994 Bay/Delta standards supersede the D-1485 standards. The goal of the new Bay/Delta plan is to establish water quality control measures that will protect the beneficial uses of the Bay/Delta estuary. The plan is a comprehensive management measure for the protection of the estuary's beneficial uses that include salinity (from saltwater intrusion and agricultural drainage) as well as water project operations (flow and diversions). Details of the plan are published in the "Draft Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary" (SWRCB, 1994) and summarized in "Principles for Agreement on Bay-Delta Standards between the State of California and the Federal Government, 1994."

- Cross Valley Canal diversions were not included.
- Shasta temperature control device is completed and operational.

CHANGES IN CVP OPERATIONS

Under the No-Action Alternative, the 1995 agreement (Agreement) between SAFCA and Reclamation, which has secured a temporary increase in the space allocated to flood control in Folsom Reservoir, would be indefinitely extended. For purposes of this SEIS/EIR, it is expected that, by virtue of this extension, the operation of Folsom Reservoir and the other CVP facilities north of the Delta would be permanently modified, as necessary, to meet the requirements of the flood control diagram (1993 Diagram) contained in the Agreement. Two models have been created to evaluate the socioeconomic and environmental consequences of these operational modifications; the "Baseline Condition Model" and the "No-Action Model." Under the Baseline condition model, it is estimated that as of October 31, 1999, the termination date of the Agreement, Folsom would revert to operation in accordance with the Corps' 1986 flood control diagram (1986 Diagram). Under this model, the recreational improvements and temperature control shutters installed at Folsom Dam required under the Agreement remain in place, and CVP operations are adjusted to reflect reasonably foreseeable water demands for consumptive use and environmental needs through 2020. Under the No-Action ("permanent reoperation") Model year 2020 water demands are assumed, CVP operations are adopted to comply with the 1993 Diagram. The No-Action Alternative is in turn used as the basis for evaluating (1) the adverse operational impacts associated with increasing the amount of storage space allocated to flood control as proposed under the Folsom Modification Plan and (2) the positive impacts of reverting Folsom Reservoir operations to the 1986 Diagram as proposed under the Detention Dam Plan.

Various mitigation measures have been implemented for the interim reoperation agreement. Permanent reoperation would likely require the same and possibly additional mitigation measures which are described below.

WATER SUPPLY

CVP/SWP Water Deliveries

Baseline. The potential impacts of permanent reoperation on water supply were assessed by examining the changes in CVP/SWP water storage and delivery between the Baseline 1986 Diagram and the No-Action Alternative. PROSIM output for the following variables was compared to assess water supply impacts:

- CVP export pumping.
- SWP export pumping.
- CVP north of Delta deliveries.
- CVP south of Delta deliveries.
- CVP storage in Clair Engle, Shasta, and Whiskeytown Reservoirs and the CVP share of San Luis Reservoir.
- CVP storage in Folsom Reservoir.
- SWP storage in Oroville Reservoir and the SWP share of San Luis Reservoir.

No-Action Condition. Increasing the amount of flood storage in Folsom would (1) on net, reduces the amount of water the CVP/SWP systems can deliver and (2) reduce the overall ability that the system has to deliver water. On average, the changes are relatively small compared to the total delivery of the CVP and SWP. In many years, there would be little to no adverse change, as the system can refill following the winter drawdown. Modeling studies indicated that in some years the greater space requirement in Folsom Reservoir would actually result in an increase in available water supplies. However, in other years the system cannot completely recover due to reduced inflows, and resulting adverse impacts would be sizeable.

The export and delivery quantities were computed as the average annual amount, while the storage conditions were computed as monthly averages. PROSIM was run for a 70-year database that approximates hydrologic conditions for the period 1922 through 1991. (See table 6-1.) Hydrology for this period reflects wet and dry years; therefore, using the results for the entire simulation reflects an average condition. The results for the period 1928 through 1934 were also examined to assess the impacts during an extended dry period. The purpose of displaying and discussing the January 1994 EPA standards is to demonstrate that there are very small differences between the two standards.

As indicated in table 6-1, the differences in average annual water export and delivery between the Baseline and No-Action Alternative under January 1994 EPA standards and December 1994 Bay/Delta standard are small (less that 0.2 percent).

Water supply impacts were also measured in terms of available storage in CVP and SWP reservoirs. Because the Baseline and No-Action Alternative incorporate rule curves with different storage targets for Folsom Reservoir, the water supply available from that facility varies. However, since CVP reservoirs are operated together, changes in storage in Folsom may be offset by changes in other reservoirs. Table 6-1 indicates the extent of the variation in average monthly storage for Folsom Reservoir for the average condition (1922 through 1991). The average monthly storage decreases are about the same (less that 1.8 percent) under both January 1994 EPA standards and December 1994 Bay/Delta standards. Table 6-1 also indicates that although the No-Action Alternative rule curve affects Folsom Reservoir storage, the impacts on storage in the entire CVP and SWP systems are relatively small (less than 0.3 percent) under both regulatory standards.

TABLE 6-1

Water Supply Impacts for Average Years (1922-1991) (1,000 acre-feet)

No-Action Alternative Less Baseline								
	January 1994 EPA Standards				December 1994 Bay/Delta Standards			
	1995		2020		1995		2020	
Annual Averages								
CVP Export Pumping	- 0.4	(0.16%)	-0.0	(0.00%)	0.0	(0.00%)	- 0.1	(<.01%)
SWP Export Pumping	0.0	(0.00%)	0.1	(<.01%)	0.0	(0.00%)	0.0	(0.00%)
CVP North of Delta	- 1.2	(0.04%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
CVP South of Delta	- 4.2	(0.17%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
SWP South of Delta	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
Total Project Delivery	- 5.4	(0.07%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
Averages								
CVP Storage excluding Folsom	- 2.5	(0.05%)	- 4.8	(0.09%)	- 3.3	(0.06%)	- 2.7	(0.05%)
Folsom Storage	- 9.2	(1.62%)	- 9.6	(1.76%)	-10.2	(1.71%)	- 9.0	(1.55%)
SWP Storage	- 5.9	(0.19%)	- 7.2	(0.23%)	+ 4.6	(0.14%)	- 6.6	(0.20%)
Total Storage	-17.6	(0.19%)	-21.6	(0.24%)	-18.1	(0.19%)	-18.3	(0.20%)

Note: Baseline = 400 TAF Fixed
No-Action Alternative = 400-670 TAF Flexible
Impact = No-Action Alternative less Baseline, 1,000 acre-feet, (percent of total system).

Similarly, a comparison of the deliveries for the dry period 1928 through 1934 shows that the impacts in export and delivery are identical under January 1994 EPA standards and December 1994 Bay/Delta standards (table 6-2). In fact, under both standards, there appears

to be no impact on CVP or SWP deliveries between the Baseline and the No-Action Alternative.

An examination of table 6-2 also shows that impacts on Folsom storage are smaller (less than 1.6 percent) for the 1928 through 1934 dry period relative to those for the average condition of 1922 through 1991. The changes in storage in the remainder of the CVP and SWP system are a little higher (less than 0.6 percent) relative to those for the average condition. As indicated, these storage changes are not reflected in changes in delivery during this dry period. These conclusions are true for simulations under both the January 1994 EPA standards and the December 1994 Bay/Delta standards.

TABLE 6-2

Water Supply Impacts for Dry Years (1928-1934) (1,000 acre-feet)

No-Action Alternative Less Baseline								
	January 1994 EPA Standards				December 1994 Bay/Delta Standards			
	1995		2020		1995		2020	
Annual Averages								
CVP Export Pumping	-0.4	(0.02%)	-0.8	(0.05%)	-0.8	(0.04%)	-3.0	(0.16%)
SWP Export Pumping	+4.3	(0.21%)	0.0	(0.00%)	0.1	(<.01%)	+0.3	(0.01%)
CVP North of Delta	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
CVP South of Delta	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
SWP South of Delta	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
Total Project Delivery	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)	0.0	(0.00%)
Averages								
CVP Storage excluding Folsom	-12.1	(0.33%)	-3.7	(0.10%)	-11.5	(0.30%)	+1.2	(0.03%)
Folsom Storage	- 2.5	(0.49%)	-3.5	(0.73%)	-8.1	(1.55%)	-1.7	(0.35%)
SWP Storage	-12.2	(0.52%)	+6.6	(0.27%)	+9.6	(0.42%)	+4.2	(0.19%)
Total Storage	-26.8	(0.41%)	-0.6	(0.01%)	-10.0	(0.15%)	+3.7	(0.06%)

Note: Baseline = 400 TAF Fixed
No-Action Alternative = 400-670 TAF Flexible
Impact = No-Action Alternative less Baseline condition, 1,000 acre-feet, (percent of total system).

The previous discussion and tables indicate that the effects remain similar and minor regardless of the assumptions used in the analysis. In addition to the simulations shown in tables 6-1 and 6-2, simulation runs were conducted incorporating potential EBMUD demands on the American River. Water supply reoperation effects on the CVP again remained similar. Additional information on various simulations is available in the Montgomery Watson reoperation report, February 1996.

The minor effects on delivery and storage, however, can be significant to water uses in economic terms. Table 6-3 presents effects in terms of the system's ability to deliver water. It shows delivery changes derived from PROSIM as well as storage changes (from PROSIM) converted to potential deliveries. The positive and negative numbers indicate that reoperation occasionally increases delivery and storage, and some years reoperation causes reductions. For example, for the No-Action condition, the net effect of reoperation is an average reduction of 9,000 acre-feet a year. The development of table 6-3 is discussed in the SIR, chapter VII.

TABLE 6-3

Water and Power Impact[1]

Item	Reoperation Scenario		
	400 to 400/670	400/670 to 475/720	400 to 475/720
Water delivery (TAF/yr)[2]			
Indicated delivery	0	+11 and - 4	+11 and - 4
Equivalent delivery[3]	+5 and -14	+11 and -31	+12 and -38
Total	+5 and -14	-22 and -35	+23 and -42
Power			
Energy (GWh/yr)[2]	-12	- 6	-18
Capacity[4] (MW/mo)[2]	- 3	- 12	- 16
Local Pumping (GWh/yr)	-0.1	-0.3	-0.4

[1]Based on year 2020 demands and 70-year period of analysis.
[2]TAF = 1,000 acre-feet; GWh = 1 million kilowatt hours; MW = 1 million watts
[3]Equivalent delivery is the average annual potential delivery or deliver reduction due to storage change.
[4]Capacity is the average maximum seasonal reduction in CVP MW capacity.

Local Water Supply

Baseline. Water agencies that obtain their water from Folsom Reservoir are affected by fluctuating water-surface elevations in the reservoir in two ways. First, as the reservoir pool drops below the elevation at which water can be delivered by gravity, the water agencies need to pump to reach their distribution systems. The lower the water-surface elevation, the greater the amount of energy needed to run the pumps, increasing the water agencies' operating expenses. The six agencies that are affected by changing water levels in

Folsom Reservoir include the City of Roseville, SJWD (San Juan Water District), and PCWA (Placer County Water Agency) on the North Fork Pipeline, Folsom Prison and the City of Folsom on the Natoma Pipeline, and EID (El Dorado Irrigation District). Important water-surface elevations related to water supply from Folsom Reservoir are presented in table 6-4.

Reservoir operations under the Baseline can result in conditions in which the capability of the Folsom Pumping Plant is reduced below that necessary to provide full water supplies to the North Fork and Natoma pipelines. The pumping plant's capacity is a

function of reservoir elevation. During water years characterized by less than normal inflows, the elevation typically declines to levels which restrict pumping in the summer. The lowest elevation reached in the Baseline simulation is 334.9 feet, which is above the absolute minimum level needed by all agencies to pump water with their existing facilities (table 6-4). However, at this level, pump efficiencies would be severely affected, reducing the amount of water that could be pumped during a given 24-hour period while increasing pumping costs.

No-Action Condition. Under the No-Action Alternative, there would be periods when local water agencies would be affected by the lower water surface elevations in Folsom Reservoir. More pumping (and thus greater energy consumption) would be required due to the lower water surface. However, the reoperation would not induce very low water levels, such as occur in a drought, that would affect water supply availability. The increased energy consumption, derived from the lake level differences modeled in PROSIM adds up to about 0.1 GWh per year on an average annual basis. The yearly impact would vary widely with the extent of drawdown done under the flexible flood space plan. At 100 mils per KWh, that total cost would be about $10,000 per year distributed as follows: North Fork Pipeline $6,000, Natoma Pipeline $2,000, EID $2,000.

HYDROPOWER

Baseline

Changes in hydropower deliveries from the No-Action Alternative can be segmented into two basic types: (1) affect project capacity and (2) affects on project energy production. Hydropower impacts are experienced when CVP reservoirs are drawn down lower (reduced capacity at the powerplants and efficiency for releases), when releases are diminished (reduced energy), or when project uses are increased (increased energy and capacity requirements).

No-Action Condition

Potential hydropower changes were assessed using the power subroutine of PROSIM to describe the power generation and capacity of the CVP system north of the Delta and at Folsom Reservoir. The average annual generation is 4,700 GWH, of this total Folsom total,

TABLE 6-4

Folsom Reservoir Water-surface Elevations and Pumping Relationships

Surface Elevations	Storage (acre-feet)	Pumping Relationship
≤433	≤638,300	Pumping to Roseville and SJWD during irrigation season (April - October)
≤425	≤567,400	Pumping required to Roseville and SJWD during nonirrigation season
≤414	≤477,700	Pumping begins to Folsom and Folsom Prison
≤356	≤157,100	EID pumps begin to develop vortex problems
≤340	≤110,600	Potential vortex at dam intake, depending on volume of pumping
≤335	≤98,800	Folsom Pumping Plant limited to 70 cfs.
≤325	≤78,300	Lower limit of EID pumps and Folsom Pumping Plant; pumps on barges required to pump water to existing intakes
≤315	≤61,200	Elevation of Folsom Dam water intake; tap penstocks
≤307	≤49,600	Elevation of power penstocks; portable pumps placed on a barge to supply pipeline intake

Source: Corps 1992b

produces 600 GWH. There would be an average annual reduction of 12 GWh. The average annual capacity of CVP north of the Delta is 1,240 megawatt/month capacity. Of this 180 megawatt/month comes from Folsom. There would be an average capacity reduction of 1 megawatt/month. This level of change is small, especially considering that the collective CVP system north of the Delta shows even smaller changes. The northern California power grid allows alternative sources such as the 1,000 GWh and 1,000 MW hydropower facilities in the upper American River to supplement Folsom Dam power.

RECREATION

No-Action Condition

<u>Lower American River</u>. Boating (rafting, canoeing, and kayaking), swimming and wading, and fishing are important water-dependent recreation activities along the lower American River. Approximately 90 percent of all boating and swimming on the lower American River takes place between Memorial Day and Labor Day. Fishing is a year-round activity.

Boating, swimming, and wading are affected by flows and water temperature. Low flows typically affect boating by reducing stream velocity, so river-travel time and congestion increase. Swimming and wading opportunities can be limited by the number of usable areas along the river, which decrease during periods of low flow, and low water temperatures during periods of high flow.

Fishing opportunities along the lower American River are affected by the abundance of sport fish (chinook salmon and steelhead trout).

Folsom Reservoir. Folsom Reservoir supports numerous water-based activities such as boating, waterskiing, and fishing. The shoreline provides sandy swimming beaches, both formal (with lifeguard services) and informal. Surrounding Folsom Reservoir is a landscape with important scenic, natural, and cultural values. Recreational facilities include camping and picnic areas, boat launch ramps, restrooms, concessions, bicycle and mountain bike trails, and equestrian trails and staging areas.

Most visitation at Folsom Reservoir is in the summer, when recreation focuses primarily on water-based activities including swimming, windsurfing, fishing, boating, boat camping, jetskiing, and scuba diving. Winter visitation is substantially lower; use consists mainly of fishing and passive recreation.

Water-surface elevations directly affect the availability and quality of boat ramps, beaches, berth sites, and other facilities which depend largely on water depth or surface area. As these facilities become unavailable to users, use patterns and visitation is altered. In addition, visual resource values closely associated with the recreational experience are affected by water-surface elevations and influence how, and the degree to which, recreationalists use the resources of Folsom Reservoir.

Upper American River. Reclamation contracted with the Department of Parks and Recreation to provide recreation and public-use management services on the lands within the boundaries of the multipurpose Auburn Dam project, known as the ASRA (Auburn State Recreation Area). The ASRA includes 42,000 acres and 48 miles of the American River from the damsite to the Iowa Hill bridge on the North Fork and to Oxbow Reservoir on the South Fork.

Its nearness to major population centers and diverse recreation base make the ASRA one of the most used and significant recreation resources in northern California. Local interest in recreation is very heavy. Bicycling has increased dramatically in the area. There is continuing demand for equestrian trails and other trails. The Tevis Cup horse race and the Western States Run, both 1-day, 100-mile events use the Western States Trail from Auburn to Squaw Valley. These events draw entrants from around the world. Additionally, the Western States Trail has been included as the trans-Sierra route of the proposed coast-to-coast American Discovery National Trail. Whitewater boating on the Middle and North Forks of the American River is of State and national significance. Both forks offer overnight camping opportunities, hiking trails, cultural and natural observation sites, and a diversity of

difficulty in whitewater rapids from beginning to advanced boating skill levels. The nearby South Fork of the American River offers a less challenging whitewater experience, and because of the predominance of private lands and development along the river corridor, camping is restricted. The nearest similar "wilderness" whitewater river, providing overnight trips, is the Tuolumne River, about 100 miles southeast of the recreation area. Approximately 72 miles of hiking trails, 66 miles of equestrian trails, and 15 miles of fire road are open to mountain bikes in the ASRA and provide year-round recreation opportunities.

FISHERIES

Baseline

Lower American River. The Baseline in the lower American River is considered to be only marginal for anadromous fish production, especially during low-flow years. Increased water temperature, decreased water quality, reductions in the quantity and quality of spawning gravel, and a decline in hatchery production contribute to this potential reduction of the anadromous fishery resource.

Fall-run chinook salmon continue to be the primary species of management concern in the lower American River. This approach reflects the consensus reached by participants in Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge Decision)—a consensus which included as management priorities ". . . maximize the in-river production (that is, spawning, juvenile survival) of chinook salmon in the Lower American River" and ". . . maximize the in-river production of steelhead trout to the extent that it does not interfere with chinook salmon management." However, because NMFS received a petition on February 14, 1994, to list steelhead trout throughout its range in Washington, Idaho, Oregon, and California, the issue of management priorities in the lower American River merits additional discussion.

High water temperature above during summer and fall is the environmental factor that is the most limiting to natural production of steelhead trout in the lower American River (Snider and Gerstung, 1986; DFG, 1991c). Historically, steelhead trout migrated upstream to their primary spawning and rearing areas in the upper forks of the American River and its tributaries. In these upper reaches of the American River system, juvenile steelhead trout reared for at least 1 year before migrating downstream to the Pacific Ocean. Cool water temperatures in the upper reaches of the system made this extended rearing component of their life history possible. Today, the historical spawning and rearing areas are inaccessible to steelhead trout, and, due to dam construction, spawning and rearing in the American River system is restricted to the lower American River—an area subjected to elevated water temperatures. Consequently, it is believed that few juvenile steelhead trout survive through the summer and fall (DFG, 1991c).

In addition to the river itself, high water temperatures at the Nimbus Fish Hatchery during late summer and fall are problematic for rearing steelhead trout, even during good water years. High water temperatures promote the growth of disease organisms. Treatments for these diseases are expensive and contribute significantly to the cost and ineffectiveness of raising steelhead trout to yearling size (DFG, 1991c). Currently, modernization plans for the hatchery do not address the problems of high water temperatures during summer and fall at the hatchery. There are no formal plans or processes under way to resolve the problem of high water temperatures (DFG, 1991c).

Folsom Reservoir. Folsom Reservoir operations under the Baseline adversely affect resident warmwater species in two ways. First, the water-surface elevation in Folsom Reservoir is reduced by an average of 39.3 feet between June and September, a critical time in year-class development. Such drawdowns eliminate an average of 2,567 surface acres of water (25.6 percent of total), much of which is in sheltered coves containing flooded terrestrial vegetation. This loss of juvenile rearing habitat resulting from summer drawdown is thought to have the greatest negative effect on annual production of fish in Folsom Reservoir (D. Lee, DFG pers. comm. 1994). Second, fluctuations in water levels cause dewatering and flooding of nests and reduce the spawning success. As a result, annual production of bass, sunfish, crappie, bullhead, and catfish is low, and the population of these species tends to be marginal compared to those found in similar natural reservoirs that do not suffer such wide fluctuations in water level.

Upper Sacramento River. NMFS has determined that a daily average water temperature of less than or equal to 56 °F is required in the Sacramento River between Keswick Dam and Bend Bridge from April 15 through September 30 to protect winter-run chinook salmon spawning and incubation. NMFS, in its 1993 biological opinion, specified a minimum flow release criteria for October through March of 3,250 cfs at Keswick Dam.

No-Action Condition

Lower American River

Flow Impacts. Under the No-Action Alternative, the frequency with which lower American River flows would meet or exceed the Hodge flows would increase by 5 percent in October through February (165 out of 350 months), decrease by 1 percent in March through June (146 out of 280 months), and remain unchanged in July through September (160 out of 210 months) compared to the Baseline condition. Chinook salmon spawning flows may improve slightly (see table 6-5). In general, flow impacts on physical habitat in the lower American River would be similar to those under the Baseline.

Water Temperature Impacts. An analysis of daily exceedence frequencies based on the historical relationship between reservoir storage, lower American River discharge, and maximum daily water temperatures in the lower American River was not required because the alternatives to be analyzed include operation of the temperature control

device at Folsom Dam, which is expected to alter the relationship among lake level, discharge, and water temperature.

Chinook Salmon. Under the No-Action Alternative, the frequency with which monthly water temperatures would exceed optimal water temperatures for chinook salmon spawning and incubation (56°F) in October and November would be increased by 0-2 percent (123-113 out of 138 months) (depending on distance downstream from Nimbus Dam) compared to the Baseline. The frequency with which temperatures at Nimbus Hatchery would exceed 56 °F (based on monthly water temperatures at Nimbus Dam) would increase by 2 percent (123 out of 207 months). Therefore, no significant changes would occur in temperature impacts on in-river and hatchery production of chinook salmon.

TABLE 6-5

Exceedence Frequencies of Recommended Flows for the Lower American River (Hodge flows)

		Exceedence Frequencies in Months
Fisheries Impact Threshold Flows	Number of Months (Relevant Period)	400-670 TAF (No-Action Alternative)
2,000 cfs	350 (Oct-Feb)	165 (47%)
3,000 cfs	280 (Mar-Jun)	146 (52%)
1,750 cfs	210 (Jul-Sep)	160 (76%)

A slight decrease or no change in exceedence frequencies would occur in the spring relative to the chinook salmon rearing and emigration threshold (60°F). Therefore, water temperature impacts on chinook salmon rearing and emigration success would not change significantly relative to the Baseline.

Steelhead Trout. Under the No-Action Alternative, the frequency with which monthly water temperatures would exceed optimal water temperatures for steelhead trout spawning and incubation (52°F) would decrease by 3 percent (111 out of 207 months) at Nimbus Dam and remain unchanged at the downstream stations relative to the Baseline.

As under the Baseline, monthly water temperatures in summer would continue to exceed the rearing threshold (60°F) in all years. A 2 percent increase (178 out of 276 months) or no change would occur in exceedence frequencies relative to the steelhead trout emigration threshold. Therefore, no significant adverse impacts on steelhead trout rearing and emigration success would occur.

<u>American Shad, Striped Bass, and Sacramento Splittail</u>. Under the No-Action Alternative, no changes would occur in the frequency with which monthly water temperatures would exceed spawning temperature thresholds (68°F) for American shad, striped bass, and Sacramento splittail. Therefore, water temperature impacts on the spawning success of these species would be similar to those under the Baseline.

<u>Flow Fluctuation Impacts</u>. Under the No-Action Alternative, the frequency of flow reductions of 50 percent or more during the chinook salmon spawning and incubation period would remain unchanged in October through January and increase by 1 percent in November through February and December through March. The frequency of 50 percent flow reductions during the steelhead trout spawning and incubation period would increase by 1 percent in January through April and 6 percent in February through May. Therefore, redd stranding impacts on chinook salmon and steelhead trout were considered less than significant.

Potential stranding impacts on Sacramento splittail would be similar to those under the Baseline. The frequency of reductions in river stage of 1 foot or more would decrease by 1 percent during the principal splittail spawning and early rearing period.

<u>Folsom Reservoir</u>

<u>Black Bass Spawning and Rearing Habitat</u>. Under the No-Action Alternative, differences in annual black bass (spotted bass and largemouth bass) spawning and rearing habitat values would range from a 13 percent decrease in largemouth bass spawning habitat to a 20 percent increase in black bass rearing habitat relative to the Baseline. Under Baseline conditions black bass spawning habitat values would range from 563 to 3,734 acres for largemouth bass spawning habitat, 1,502 to 5,514 acres for spotted bass spawning habitat, and 1,376 to 7,605 acres for black bass rearing habitat. Median differences in black bass habitat values would be zero to 1 percent. No significant changes in black bass spawning and rearing success would occur.

<u>Spawning Success of Warmwater Fish</u>. Under the No-Action Alternative, the frequency of reservoir drawdowns of two feet or more per month during the primary spawning months for warmwater game fish (March through July) was reduced by 1 percent during the 70-year simulation period. Such drawdowns eliminate an average of 2,567 surface acres of water (25.6 percent of total), much of which is in sheltered coves containing flooded terrestrial vegetation. Because these drawdowns occur infrequently, impacts on spawning success of warmwater game fish would be similar to those under the Baseline.

<u>Coldwater Fish Habitat</u>. Under the No-Action Alternative, average monthly reservoir storage would be reduced by 2 to 7 percent in December through March, increased by 2 percent in September and October, and reduced by zero to 1 percent in the remaining months. Reductions in reservoir storage during winter are not expected to cause significant adverse impacts on the reservoir trout fishery because coldwater habitat is unlikely to be limiting the abundance of stocked trout, especially during the cooler months of the year when

the reservoir is thermally mixed. Lower reservoir storage during the winter may actually improve feeding opportunities for rainbow trout by increasing prey availability.

Upper Sacramento River. Under the No-Action Alternative, flow impacts on fishery resources in the upper Sacramento River would be similar to those under the Baseline. No change would occur in the frequency with which flows would meet the October through March minimum release criterion of 3,250 cfs at Keswick Dam.

A slight decrease or no change would occur in the frequency with which monthly water temperatures would exceed the chinook salmon spawning and rearing thresholds in the upper Sacramento River, including those established for winter-run chinook salmon spawning and incubation thresholds (56°F) and rearing threshold (60°F). Therefore, temperature impacts on chinook salmon spawning and rearing success in the upper Sacramento River would be similar to those under the Baseline.

Downstream from American River. Implementing the No-Action Alternative would have little or no effect on flow and water temperature impacts on fisheries resources in the lower Sacramento River would be similar to those under the Baseline. Changes in average monthly flow at Freeport would be 1 percent or less in all months.

Impacts of Delta outflows and total Banks and Tracy exports on fisheries resources would be similar to those under the Baseline. Changes in average monthly Delta outflow and exports would be 1 percent or less in all months.

Shasta Reservoir. Implementing the No-Action Alternative would have little or no effect on Shasta Reservoir fish habitat and populations. Average monthly reservoir storage differed by less than 1 percent from storage levels under the Baseline. Under the Baseline condition the September carry-over storage at Shasta Reservoir is 1.9 million acre-feet.

No change would occur in the frequency with which September storage levels would meet the carryover storage criteria for water temperature control in the upper Sacramento River. Therefore, storage-related water temperature impacts on winter-run salmon spawning success would be similar to those under the Baseline.

Clair Engle Reservoir. Implementing the No-Action Alternative would have little or no effect on changes in reservoir storage on reservoir fish habitat or populations. Changes in average reservoir storage would be less than 1 percent in all months.

VEGETATION AND WILDLIFE

Lower American River

Baseline. The natural processes that support and maintain stands of riparian vegetation and the associated riparian wildlife community were substantially altered in the

lower American River by the construction of Folsom and Nimbus Dams. The flow regime and typical annual hydrograph for which the riparian vegetation was adapted has changed such that annual high flows no longer coincide with the time many of the riparian species such as cottonwood and willow shed their seed. In addition, the dams have blocked the transport of much of the upstream sediment. Consequently, deposition of sediment along the banks of the lower American River during high flows, which is necessary for providing an adequate seed bed suitable for the establishment of riparian plants, has been minimized. The elimination of sediment transported from upstream has also resulted in increased erosion and transport of sediment out of the lower American River and incision of the river channel. This condition has led to the migration of the river away from the existing riparian community. Hence, the dams have impaired natural regeneration of the riparian community along the lower American River and the ability of the river to support existing vegetation.

Wetland areas in the river's side channels and isolated ponds have also been affected by changes in the river's flow regime over time. As the river channel continues to meander, wetlands dependent upon recharge from floodwaters and/or ground water supported by streamflow may be eliminated or flooded permanently. Similarly, long-term abundance and distribution of sensitive plant and wildlife species associated with riverine and riparian habitats, as well as the wildlife community as a whole, may change in response to changes in the riparian community.

<u>No-Action Condition</u>. The No-Action Alternative would generally result in increased flows during late fall and early winter as flood storage is increased in the reservoir and reduced flows during the spring while the reservoir is refilled. This change in the existing flow regime will not influence, either detrimentally or beneficially, the riparian community's ability to regenerate. Therefore, the focus of the impact analysis is on maintenance of existing vegetation and wetlands.

Existing riparian vegetation can be affected by changes in flow in several ways:

(1) Reduction in spring flow that prevents recharge of backwater channels and isolated ponds;

(2) Inundation for extended periods during the growing season;

(3) Change in the flow regime such that the frequency of low-flow conditions during the growing season is increased; and,

(4) Change in the frequency, duration, and depth of peak floodflows that promote cottonwood and willow regeneration on flood plain terraces.

Based on the requirements of the 1993 Diagram, flows under the No-Action Alternative will differ from those under the Baseline only infrequently ($\leq$12 years) during January and May through December. Additionally, the flow differences during these months were generally minor. In February, March, and April, flows under the No-Action

Alternative differed from the Baseline in 43, 33, and 20 of the 70 years evaluated, respectively. Although February showed the highest frequency of flow differences, the magnitude of the flow change would be minor.

An analysis of the frequency of modeled flows (at 500 cfs intervals) during each month over the entire period of record indicated that the frequency of flow levels between 3,000 and 3,500 cfs during March and April is higher under the No-Action Alternative than under the Baseline and lower for flows between 3,500 and 8,500 cfs. There were no differences at flows below 3,000 cfs.

Pond and Backwater Recharge. The riparian vegetation associated with the numerous side channels and isolated ponds along the lower American River is dependent in large part on annual recharge of these areas by high flows in the spring. Reduced spring flows could affect the ability of these areas to recharge. From field studies conducted on the lower American River, Sands (1985) concluded that flows of 2,750 cfs and 4,000 cfs were necessary to recharge the ponds closest to and farthest from the river channel, respectively. The physical solution outlined by Judge Hodge in the *EDF et al. v. EBMUD* decision, which took into consideration the study results of Sands (1985) and others, requires maintaining a flow level of at least 3,000 cfs during the spring to protect lower American River resources, including riparian vegetation and adjacent pond communities. This flow level was used as the threshold criterion for significance.

In dry water years when pond recharge may be reduced, riverflows under the No-Action Alternative would not differ from the Baseline. Specifically, reservoir operations under the 1993 Diagram would not increase the frequency of flows below 3,000 cfs. In wetter years, flow levels may be reduced, but would not fall below 3,000 cfs during March through June, the growing season for vegetation along the ponds. Accordingly, no significant adverse impacts to riparian vegetation are anticipated as a result of failure to recharge backwater areas under the No-Action Alternative.

Seasonal Inundation. During the primary growing season, March through June, the frequency of inundation of nearshore vegetation would not increase under the No-Action Alternative. In all modeled years, flows were equal to or less than those under the Baseline during March through June. Hence, no adverse impacts on riparian vegetation are expected. During periods of reduced activity (September through January), the No-Action Alternative would result in only minor changes in flow which would not significantly alter the frequency of inundation.

The maximum objective release from Folsom Reservoir will remain at 115,000 cfs. During extreme storms, the overbank areas would be flooded to near the levee tops, as happens under the 1986 operating diagram. When this happens, mobile wildlife species escape to dry areas outside the levees. Nonmobile or hibernating individuals would be killed. This is no change from the Baseline.

Water Availability. Because of past channel incision and the migration of the river channel away from stands of riparian vegetation, extreme low-flow conditions may reduce moisture in the root zone in areas supporting existing riparian vegetation. As with backwater and pond recharge, the 3,000 cfs flow level contained in the Hodge flows was intended to provide an adequate level of protection for existing riparian vegetation. Therefore, the 3,000 cfs flow level was used as the criterion for maintaining existing vegetation. Under the No-Action Alternative, flow levels during March through June are identical to the Baseline in dry years when flows are below 3,000 cfs. In the remaining years, flows are always equal or in excess of 3,000 cfs. Therefore, the No-Action Alternative is not expected to adversely affect riparian vegetation.

Wildlife. The riparian plant community and wetlands along the lower American River will not be significantly affected under the No-Action Alternative. The wildlife community associated with these habitats is not expected to change. With respect to the riparian and open water species such as piscivorous birds (for example, mergansers, herons, egrets, and kingfishers) which are dependent upon fisheries, a no-impact finding is appropriate based on the determination (discussed above) that the No-Action Alternative would not adversely affect lower American River fisheries.

Lake Natoma. Lake Natoma serves as a regulating afterbay that moderates releases from Folsom Reservoir. Operation of Lake Natoma will not change as a result of the No-Action Alternative, and fluctuations in water-surface elevation will not differ from the Baseline. Therefore, no significant impact on the riparian vegetation, wetlands, and wildlife associated with Lake Natoma is expected.

Folsom Reservoir. As described in the environmental setting, Folsom Reservoir supports a minimal amount of riparian vegetation in the drawdown zone because of the widely fluctuating water-surface elevations resulting from reservoir operation. Typical riparian vegetation does exist where tributary streams enter the reservoir; however, this vegetation is supported primarily by streamflow rather than reservoir level. Because of the recent drought, portions of the drawdown zone have been exposed for a sufficient duration to allow the temporary establishment of some vegetation (primarily willows). These vegetated areas will be lost when reservoir levels rise in response to wetter hydrologic conditions. Accordingly, the No-Action Alternative would not affect riparian vegetation at Folsom Reservoir.

Wetlands do not exist within the drawdown zone, although the FWS (1992) identified established backwater marsh areas in the reservoir that are normally inundated but may become dewatered under reoperation. These areas, which exist primarily near the upper arms, provide habitat for migrating waterfowl during winter. In wet years, these backwater marsh areas may not be inundated due to an increased drawdown. However, the frequency of dewatering of these areas would not substantially increase under the No-Action Alternative. Therefore, there would be no significant impact to this vegetation or to waterfowl using these habitats.

Reoperation of Folsom Dam would alter flow patterns during nonflood periods in the lower American River from those under the without-project conditions. In general, flows would be higher in the late fall, winter, and early spring as Folsom Reservoir releases maintained required flood space. Flows would be somewhat less in the late spring as flows are decreased to allow Folsom Reservoir to fill. The principle water-dependent recreation activities affected by these altered flow would be boating (including rafting, kayaking, and canoeing), swimming, and wading.

Approximately 2,000 cfs is the minimum flow necessary to support all forms of boating (kayaking, rafting, and canoeing), and 1,500 cfs is the minimum flow required to support wading and swimming (Watson, 1985).

After high flows, recreational use of trails and parks would be interrupted until repairs were made or cleanup completed. This would particularly affect low-lying portions of the bicycle trail that are prone to wash out a high flows. Some vegetation would also be altered due to higher flows affecting, at least temporarily, the visual resource value of the riverine environment to recreationists.

ENDANGERED SPECIES

Baseline

A complete discussion of listed species which may be affected by the No-Action Alternative may be found in chapter 4. Table 4-2 lists sensitive plant and wildlife species, their scientific names, and their status.

No-Action Condition

Lower American River.

Winter-run Chinook Salmon (*Oncorhynchus tshawytscha*, Federal and State Endangered). The winter-run chinook salmon inhabits the Sacramento River and possibly the American River up to Nimbus Dam. Successful spawning has been recorded between Keswick Dam and the Red Bluff Diversion Dam. This species should not be adversely affected by the No-Action Alternative because changes in the Sacramento River flows are not expected to differ substantially from the Baseline.

Delta Smelt (*Hypomesus transpacificus*, Federal and State Threatened). The Delta smelt spends most of its life in the shallow waters of the estuarine mixing zone where salinities range from zero to 2 grams per thousand. The fish spawns in dead-end sloughs and the shallow edge-waters of channels in the freshwater zone. This species should not be adversely affected by the No-Action Alternative because changes in flow are not expected to differ substantially from the Baseline.

Sacramento Splittail (*Pogonichtys macrolepidotus*, Federal Proposed Threatened). The Sacramento splittail lives mostly in the slow-moving stretches of the Sacramento River and Delta and in small shallow sloughs and marshes. The splittail spawns between early March and mid-May. This species should not be adversely affected by the No-Action Alternative because changes in flow are not expected to differ substantially from the Baseline.

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*, Federal Threatened). Significant impacts to the beetle may result if substantial numbers of their host plant, elderberry shrubs, are affected by the flow changes associated with the No-Action Alternative. However, as described in the discussion of riparian vegetation, the riparian community as a whole, of which elderberry is a component, is not expected to be adversely affected by permanent reoperation. Despite the expected persistence of the elderberry plants themselves, individual beetles may be adversely affected if high flows inundate habitat during May and June when the adult beetles emerge. These high flows during the spring, however, will be reduced under the No-Action Alternative.

Bald eagle. (*Haliaeetus leucocephalus*, Federal and State Endangered). During winter, bald eagles are known to use Folsom Reservoir and may occasionally be observed foraging along the lower American River. The bald eagle is not a common species along the lower American River, nor is the river considered important habitat. Nevertheless, use of the river by bald eagles under the No-Action Alternative is not expected to differ from use under the Baseline.

Swainson's hawk (*Buteo swainsoni*, State Threatened). Swainson's hawk nesting sites are not believed to be limiting in the project area. Large trees suitable for nests are abundant along the river channel. Although cottonwoods are declining along the lower American River in general, it is not expected that the No-Action Alternative would either accelerate or decelerate this process by altering the overall flow regime. Therefore, no significant adverse impacts on potential Swainson's hawks nesting habitat along the lower American River are expected.

Folsom Reservoir. The sensitive species described for the lower American River, with the exception of the bald eagle, either do not occur in or near the reservoir or will not be affected by permanent reoperation.

Bald eagle. Bald eagles are known to use Folsom Reservoir during winter. Impacts resulting from the No-Action Alternative could be expected if the project caused a substantial reduction in the warm and/or cold water fishery in Folsom Reservoir. The No-Action Alternative would not result in a substantial reduction in the Folsom Reservoir fishery. Therefore, a reduction in the bald eagle prey base is not expected. Although habitat suitability at Folsom reservoir may be decreased, a significant impact on bald eagles is not expected for two reasons. First, the number of eagles and the extent to which the area is used is very low. Second, wintering bald eagles are extremely mobile and have the ability to exploit food sources over a wide geographic range. Thus, it is doubtful that the potential

reduction in habitat suitability at Folsom Reservoir would inhibit the ability of wintering bald eagles to obtain food.

Shasta Reservoir. The No-Action Alternative could alter water-surface elevations and storage levels in Shasta Reservoir. Changes in water-surface elevations would affect nearshore habitats and the distance between upland habitats and the water's edge. Nearshore areas of Shasta Reservoir support little vegetation and, consequently, are of limited value to wildlife. Changes in the distance between upland habitats and the water's edge, however, could affect bald eagle foraging at the reservoir.

Bald eagle. In most years, water-surface elevations would not differ between the No-Action Alternative and the Baseline. In the few years that water-surface elevations would be reduced, the reductions would be minor. The maximum reduction in water-surface elevation was 7.5 feet. However, reductions in water-surface elevations were less than 3 feet in most years when reductions occurred. In only 5 months of the entire period of record were water-surface elevations reduced by more than 5 feet. These minor and infrequent reductions in water-surface elevations would not result in a significant impact to bald eagle foraging.

Clair Engle Reservoir.

Bald eagle. As with Shasta Reservoir, potential impacts to wildlife at Clair Engle Reservoir would be limited to potential adverse effects on bald eagle foraging success. Bald eagles nest and overwinter at Clair Engle Reservoir, and, therefore, could be affected by reduced water-surface elevations throughout the year. In most years, water-surface elevations in Clair Engle Reservoir would not differ between the No-Action Alterative and the Baseline. In the few years that reoperation would reduce water-surface elevations, the reductions would be minor, less than 3 feet. The minor and infrequent reductions in water-surface elevations would not result in a significant impact to bald eagle foraging.

CULTURAL RESOURCES

Baseline

Lower American River. Forty-two archeological sites, 7 historic properties and 3 potentially historic railroad bridges have been identified in the lower American River area. Because the entire area has not been systematically inventoried, many more previously unidentified sites are certain to exist there. Four properties are listed in or eligible to be listed in the National Register of Historic Places, and few of the remaining properties have been evaluated for National Register eligibility. Under the Baseline, these properties, particularly the archeological sites, are subject to numerous adverse impacts, many of which are severe, including alluvial erosion and vandalism. In addition, flooding in excess of the current level of protection could cause significant damage to a number of the prehistoric and

historic archeological sites along the terraces of the lower American River. Similarly, emergency discharges in excess of the current objective release of 115,000 cfs could result in significant damage to sites.

Folsom Reservoir. Several surveys and studies have been conducted since the construction of the dam. At least 123 prehistoric sites and approximately 52 historic era properties have been recorded. Primary archival and secondary sources suggest that more than 200 other potential sites or features may exist in the reservoir (Peak and Associates, 1990). Because the entire area has not been systematically inventoried, many more previously unidentified properties may be present. The Folsom Powerhouse is the sole property at the reservoir which is listed or eligible to be listed on the National Register of Historic Places. Under the Baseline, these sites are subject to numerous adverse impacts, many of which are severe, including erosion caused by wave action, vandalism, alternate drying and inundation, and damage by offroad vehicles.

Upper American River. Previous studies have documented 1,589 historic and 125 prehistoric archeological sites in the Auburn area. Among the cultural properties in this area are numerous manmade structures, including the No Hands Bridge and the portion of the Western States Trail which are within the project area of potential effect and, which must be evaluated for National Register of Historic Places eligibility. Under the Baseline, these resources are subject to the effects of pluvial, eolian, and, to a lesser extent, alluvial erosion. In addition, they are under moderate to severe pressure from vandalism and recreational activities.

Downstream from American River. Two prehistoric archeological sites and a single historic period archeological site exist within the area downstream from American River. In addition, numerous historic period structures exist there, including the Sacramento Weir, a National Register of Historic Places-eligible property, and other unevaluated properties. No notable adverse impacts are known to be occurring with respect to these cultural properties under the current operating regime.

No-Action Condition

Lower American River. The vast majority of sites along the lower American River corridor are currently undergoing severe erosion associated with both natural processes, such as root and rodent intrusion, as well as man-induced effects such as fluctuating river levels. Increased population, land use, and related urban growth along the river corridor would continue generally as described in current local plans. Vandalism has been noted at several sites and is expected to continue. Similarly, the recreational opportunities afforded by the American River Parkway introduce additional elements of looting and collecting. Thus, the above-listed factors will continue to subject historic properties to adverse impacts under current conditions; that is, the .

Folsom Reservoir. Changes in water-surface elevations in Folsom Reservoir under the current operating regime have severely damaged most of the cultural sites within the

inundation zone of the reservoir (Waechter and Mikesell, 1994). This would continue under the No-Action Alternative.

Based on information from the California Historical Resources Information Center, 143 known sites in the Folsom Reservoir inundation zone could be affected under without-project conditions. Additional sites that have not been identified in previous surveys also may exist. Of the 143 known sites, 35 are located within 0.25 mile of designated recreation areas and are therefore subject to a higher degree of disturbance than those located farther away.

Under baseline conditions, all the 143 known sites and any unidentified sites would continue to be subjected to effects caused by wave action, vandalism, alternating drying and inundation, and inadvertent damage by offroad vehicles. The only difference between baseline conditions and the No-Action Alternative is the slightly increased likelihood of impact. However, a review of the hydrologic modeling for baseline conditions and the No-Action Alternative indicates that the differences in the level of impacts would be minor. In general, sites at higher elevations would be exposed to the greatest levels of impact, both from wave action and from human actions.

Under baseline conditions, one known site in the Folsom Reservoir inundation zone would not be affected by exposure-related impacts. The remaining 142 sites would continue to be affected by wave action and exposure similar to the effects described under Baseline conditions. An unknown number of additional cultural resource sites that have not been identified also could be similarly affected.

Downstream from American River. No adverse impacts are anticipated to historic properties in the Sacramento River area.

Shasta Reservoir. Changes in water-surface elevations in Shasta Reservoir under the No-Action Alternative would be less than those experienced in Folsom Reservoir. In about 85 percent of the 840 months of the period of record, water-surface elevations would differ from the Baseline by less than 1 foot. In about 10.5 percent of the months, water-surface elevations would be 1 to 3 feet lower, and in the remaining 4.5 percent of the months, water-surface elevations under the No-Action Alternative would be 3 to 8 feet lower. Due to the low magnitude and infrequent occurrences of differences in water-surface elevations between the No-Action Alternative and the Baseline, sites of historical or cultural significance along the shoreline of Shasta Reservoir would not be subjected to a substantial increase in exposure or wave action.

Clair Engle Reservoir. Changes in water-surface elevations in Clair Engle Reservoir under the No-Action Alternative relative to the Baseline would be minor and infrequent. In about 96.4 percent of the 840 months of the period of record, water-surface elevations would differ from the Baseline by less than 1 foot. In the remaining 3.6 percent of the months, water-surface elevations under the No-Action Alternative would be 1 to 3 feet lower. Due to the low magnitude and infrequent occurrences of differences in water-surface

elevations, sites of historical or cultural significance along the shoreline of Clair Engle Reservoir would not be subjected to a substantial increase in exposure or wave action.

WATER QUALITY

Baseline

Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. These low flows periodically result in high water temperatures that may jeopardize juvenile fish. Runoff from the portions of the lower American River area north of the river is collected and discharged into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

No-Action Condition

Lower American River.

Water quality in the lower American River is also affected by elevated water temperatures. The instances when elevated temperatures would occur are extremely rare. Therefore, the No-Action Alternative would not significantly increase the potential for conditions detrimental to water quality in the lower American River. The situation for water temperatures in the river would be improved as a result of the temperature shutters being installed by SAFCA.

Folsom Reservoir. Water-quality problems, including low dissolved oxygen concentrations and microorganism blooms that contribute to taste and odor problems in domestic water supplies, are largely attributable to elevated water temperatures. In Folsom Reservoir, these problems occur during the summer when storage falls below about 400,000 acre-feet and water temperatures exceed about 70 °F. The No-Action Alternative would not significantly increase the frequency at which these conditions would be expected.

Upper American River. Historically, water quality parameters for the American River have generally been well within acceptable limits to achieve water-quality objectives and beneficial uses mandated by the Central Valley Regional Water Quality Control Board.

Sacramento River Basin/Delta. Reclamation is required under the 1994 Bay Delta Standards to maintain water quality standards in the Delta. Compliance with the conditions in the 1994 Bay Delta Standards was an inherent assumption in the hydrologic modeling performed in connection with this SEIS/EIR.

Shasta and Clair Engle Reservoirs. Water quality at these reservoirs would remain unchanged under the No-Action Alternative.

VISUAL RESOURCES

Baseline

Lower American River. The lower American River provides a variety of visual experiences, which include steep bluffs, terraces, islands, backwater areas, and riparian vegetation. The natural environment is a refreshing contrast to the urban development of the surrounding Sacramento area.

Folsom Reservoir. Folsom Reservoir visual resources have been demonstrably negative in their natural appearance for much of the last decade, to the extent that the existing "bathtub ring" of exposed shoreline is an unappealing, and therefore negative, viewscape.

Upper American River. There would be no adverse affects to visual resources in the upper American River area.

Downstream from American River. The visual resource values of the Sacramento River system are varied and represent a complex setting of geomorphic landscapes, vegetative communities, and open and confined waterways.

Shasta and Clair Engle Reservoirs. Both Shasta and Clair Engle reservoirs are conserved under the National Recreation Area objectives which protect lands of recreational and scenic value (U.S. Department of Agriculture, 1987). Although human-made, these reservoirs have been established for many years and when full, appear essentially natural. They are both surrounded by coniferous forest. Typically, though, the reservoirs have not been full due to drought. The visual quality of the reservoirs is degraded during low water years as the drawdown zone detracts from the scenery. Shasta Reservoir can be viewed by passers-by on Interstate 5, therefore, it is exposed to significantly more viewers than is Clair Engle Reservoir.

No-Action Condition

Folsom Reservoir. Under the Baseline, visual resource values of Folsom Reservoir and the State Recreation Area would remain subject to the same natural and operational regimes to which they are now subject. Visual resource impacts would not exceed that range normally expected. The visual resource impacts of permanent reoperation should, therefore, be considered, since the reservoir has been visually impaired for some time.

Summer Season Change. Under the No-Action Alternative, reservoir water-surface elevations would only be reduced in 6 months of the summer recreation period of record (350 months [April-August for 70 years]) by an amount ranging from 2.4 to 6.1 feet. This low frequency of occurrence (1.4 percent) and low magnitude (up to 6.1 feet) of reduced elevations does not represent a significant adverse effect to visual resources.

<u>Winter Season Change</u>. In the winter recreation season (September-March), reservoir surface elevations would be reduced in 41 months of the corresponding 490-month period of record, or about 8 percent of the winter months.

- In 24 of these 41 months, or about 4.9 percent of the total months in the winter recreation season, discernible reservoir water-surface elevation reductions of 10 or more feet would result.
- In 19 of these 41 months, or about 3.9 percent of the total months in the winter recreation season, demonstrably negative reservoir water-surface elevation reductions of 20 or more feet would occur under this alternative.
- In 15 of these 41 months, or about 3.1 percent of the total months in the winter recreation season, definitively negative water-surface elevation reductions of 30 or more feet would occur under this alternative.

Based on the modeled output for the 70-year period of record, the duration of elevation reductions of 10 or more feet could have extended for one 8-month period in water year 1984, two 5-month periods in water years 1951 and 1970, and one 4-month period in water year 1965. These periods equate to 22 of the 41 winter months in which such differences could have occurred. The remaining 19 months occurred in periods of three or less consecutive months.

The data reflecting the potential duration of visual resource impacts under the No-Action Alternative, therefore, support a very small probability (1 in 70, or 1.4 percent) that such elevation reductions would persist for longer than 8 months. There would only be a 2.8 percent probability that such elevation reductions would persist for more than 5 months.

Impacts to visual resources would, therefore, be short-lived. Although the No-Action Alternative would induce, at times, substantial demonstrable negative visual effects, those effects would be temporary and would disappear as the reservoir refills to levels that would have occurred in the absence of the project (probably in about 3 months or less). As a result, the No-Action Alternative would not result in the creation of an visually offensive site and would not permanently change the visual quality of the region, or permanently eliminate visual resources since the reservoir retains the capability to refill. Visual resource impacts are, therefore, found not to be significant.

<u>Shasta Reservoir</u>. Under the No-Action Alternative, visual resource values of Shasta Reservoir would remain subject to the same natural and operational regimes to which they are now subject. There would be no additional impacts to visual resource values.

<u>Summer Season Change</u>. The No-Action Alternative could negatively affect visual resource values of Shasta Reservoir if water-surface elevations in the reservoir were substantially lowered or the frequency or duration of low water-surface elevations substantially increased.

In most years, water-surface elevations during April through August would not differ between the No-Action Alternative and the Baseline. Water-surface elevations would be reduced by more than 1 foot in 32 months of the 350-month summer recreation period of record, with a maximum reduction of 7.3 feet. In all but 3 months during the summer period of record, water-surface elevations would change by less than 5 feet. Water-surface elevations were reduced by greater than 5 feet during June, July, and August of a single year, 1970. In no years would water-surface elevations be reduced by 10 feet or more. The infrequency and low magnitude of potential reductions in water-surface elevations in Shasta Reservoir during April through August does not constitute a significant adverse impact to visual resource values.

Winter Season Change. Water-surface elevations were reduced more frequently during the winter (September through March) than during the summer. However, as with the summer season, water-surface elevations under the No-Action Alternative would not differ from the Baseline in most years. Reductions in water-surface elevations of greater than 1 foot would occur in 64 months of the 490-month period of record for the winter season. In one winter season (September 1970 through November 1971), however, water-surface elevations were reduced by greater than 5 feet, but in no years were reductions in water-surface elevation greater than 10 feet.

Clair Engle Reservoir. Under the No-Action Condition, visual resource values of Clair Engle Reservoir would remain subject to the same natural and operational regimes to which they have been subject under the Baseline.

Summer Season Change. In most years, water-surface elevations in Clair Engle Reservoir during the summer season (April through August) would not differ between the No-Action Alternative and the Baseline. In only 9 months out of 350 months of the 70-year period of record for summer months would water-surface elevations be reduced by greater than 1 foot. In August 1985, the maximum reduction was 2.5 feet.

Winter Season Change. In most years, water-surface elevations in Clair Engle Reservoir during September through March would not differ between the No-Action Alternative and the Baseline. In only 20 months out of 490 months of the 70-year period of record for the winter season would water-surface elevations be reduced by greater than 1 foot. In October 1986, the maximum reduction was 2.9 feet.

CHAPTER 7

ENVIRONMENTAL CONSEQUENCES
FOLSOM MODIFICATION PLAN

Under this plan, a new flood control diagram for Folsom would be developed, increasing the amount of fixed space storage allocated to flood control in the reservoir from 400,000 acre-feet to 475,000 acre-feet and increasing the maximum variable space component from 670,000 acre-feet to 720,000 acre-feet. In addition, the emergency spillway release diagram would be modified to reflect use of surcharge storage.

Folsom Dam. Lower the five main spillway bays 15 feet and replace the main spillway gates, enlarge the eight existing river outlets, and modify the three emergency spillway gates and strengthen the core of dikes 5 and 7 and Mormon Island Dam to permit increased surcharge storage.

Lower American River. Construct a seepage cutoff wall in the core of the Federal and non-Federal levees along both banks of the lower American River.

Downstream from American River. Strengthen 12 miles and raise 12 miles of levees along the east bank of the Sacramento River below Verona.

OPERATIONAL IMPACTS

The operational impacts of concern under this alternative are those related to the adjustments in CVP operations that would be needed to accommodate the requirements of the Folsom Modification Plan flood control diagram. These impacts, which include water supply, hydropower, recreation, cultural resources, fisheries, vegetation and wildlife, and esthetics, were identified by completing a model study comparing CVP operations under the No-Action Alternative to operations required for the variable storage requirement of 475,000 to 720,000 acre-feet of seasonal storage using the same methodology developed in the preceding discussion of the No-Action Alternative. This analysis was completed using the model runs conducted for the 475,000-670,000 acre-foot diagram. This was projected for the maximum drawdown since the reservoir would be drawn down past 670,000 acre-feet only four years during the period of analysis.

WATER SUPPLY

CVP/SWP Water Delivery

No-Action Condition. As described in chapter 6, the No-Action Alternative was used as the criteria for conducting this analysis.

Significance Criteria. As described in chapter 6, any deficiency in the amount of water which would have been delivered under existing projects is considered to be a significant adverse effect.

Impacts

The results of the modeling study indicate that the Folsom Modification Plan would significantly reduce CVP/SWP water deliveries by comparison to the No-Action Plan because additional space would be allocated to flood control at Folsom Reservoir. The average annual reduction would be about 13,000 acre-feet. Chapter VI of the Main Report and chapter 6 of this SEIS/EIR has additional information on water delivery impacts.

Mitigation

Effects to water supply under the Folsom Modification Plan result primarily from changing the minimum required space for flood storage. Mitigation for this effect could be accomplished by purchasing a larger volume of water to meet replacement needs. Purchasing CVP supplies could reduce demand on reservoirs and allow them to refill to prereoperation levels. This is an extension of the No-Action Alternative mitigation discussed in chapter 10. The estimated cost of water supply mitigation is $7.2 million.

LOCAL WATER SUPPLY

No-Action Condition

As described in chapter 6, the No-Action Alternative was used as the basis for this analysis.

Significance Criteria.

Any reduction in supply or increase in the cost of surface water supply delivery is considered a significant adverse effect.

Impacts

Under the Folsom Modification Plan, reduced water storage in Folsom Reservoir would affect the pumping energy consumption of local water agencies receiving water

directly from Folsom. Therefore, the Folsom Modification Alternative would result in additional effects to surface-water supplies at Folsom. These conditions are similar to those described in the No-Action Plan. Under the Folsom Modification Plan, lower reservoir surface elevations would require more pumping for local surface water supplies. Availability of water would not usually be affected. Increased pumping energy by local water agencies would be about 0.3 GWh per year at a cost of about $30,000 per year above No-Action Alternative. In very unusual years such as 1976 and 1977, reoperation of this degree could contribute to very low reservoir levels (if not mitigated) and affect water supply. Chapter VII of the Main Report contains more information on this topic.

Mitigation

Because of the change in flood control storage under the Folsom Modification Plan, purchasing replacement power on an annual basis to meet additional pumping costs is not cost effective. Mitigation for this effect would be accomplished by reimbursing water agencies for anticipated pumping costs. The annual cost is anticipated to be $30,000. Effects to local water supply availability that may occur in an unusual year would be mitigated by the CVP water supply mitigation plan. This plan would restore Folsom water levels to prereoperation elevation by the end of the water year.

HYDROPOWER

No-Action Condition

The hydropower effect associated with the Folsom Modification Plan can be segmented into two basic types: (1) effects to project capacity and (2) effects to project energy production. Hydropower effects are experienced when CVP/SWP reservoirs are drawn down lower (reduced capacity at the powerplants and efficiency for releases), when releases are diminished (reduced energy), or when project uses are increased (increased energy and capacity requirements).

Significance Criteria.

Any reduction in hydropower capacity or power generation attributable to the increased flood control storage of the Folsom Modification Plan is regarded as a significant adverse effect.

Impacts

The model studies indicate that the changes in Folsom Reservoir storage, release, and pumping patterns produced by the Folsom Modification Plan diagram relative to the No-Action Alternative would significantly reduce CVP hydropower generation and capacity. Average maximum seasonal capacity reduction would be about 12 MW and the average energy reductions about 16 GWh/yr. All of the alternative effects are shown in table 6-3.

These effects are a small percentage of the total CVP north of Folsom, about 4,600 GWh) and capacity of about 1,200 MW). Folsom energy production is about 620 GWh/yr, capacity is about 180 MW, and other American River Watershed (PG&E and SMUD) energy and capacity are about 1,000 GWh and 900 MW.

Mitigation

As a result of reoperation of Folsom Dam and Reservoir, there will be hydropower effects leading to generation and capacity losses. To mitigate for hydropower effects, the generation and capacity lost would have to be replaced. The generation and capacity could be replaced by importation from another part of the Western Area Power Administration hydropower grid where supply is in excess of demand.

Electrical capacity and energy have a time-dependent value. In California, during the summer when the demand for electricity is high, its value is somewhat greater than during the winter when electric demand is lower. Recognizing these value differences is desirable to evaluate the costs of any alternative. However, since the time-dependent values cannot be determined for all months of all years used in the studies, a constant value of $72 per megawatthour was used regardless of month or year. Capacity was valued at $6,000 per megawatt/month.

The average annual cost of about $1.3 million could be paid to WAPA to compensate for reduced power production.

RECREATION

No-Action Condition

Table 7-1 compares the flood control release schedules for the No-Action Alternative and the Folsom Modification Plan for a series of selected flood events. This comparison shows that releases from Folsom would be higher under the Folsom Modification Plan for events ranging in annual frequency rom about 1/5 to 1/100.

These higher releases would increase downstream water-surface elevations, potentially damaging recreational facilities and related resources in the lower American River. However, the comparative differences in flow rates for the more frequent flood events are small. Under the No-Action Alternative, even the more frequent events would produce flow rates large enough to fully inundate the floodway. Thus, the higher releases under the Folsom Modification Plan would raise water-surface elevations only in circumstances when recreation facilities in the lower American River would otherwise have been flooded; accordingly, the Folsom Modification Plan would not result in any significant damages to recreational facilities when compared to the No-Action Alternative.

Table 7-1

Comparison of Projected Peak Outflows from Folsom Dam for Selected Flood Events

	Alternative	
	No-Action Alternative **400/670** **115,000 cfs (objective release)**	**Folsom Modification Plan** **475/720** **115,000 cfs (objective release)**
5-Year Peak Duration ≥ 25,000	 60,000 3 days	 74,000 2.2 days
10-Year Peak Duration ≥ 25,000	 90,000 4 days	 115,000 3.8 days
20-Year Peak Duration	 115,0000 5.5 days	 115,000 5.6 days
50-Year Peak Duration	 115,000 10 days	 115,000 7.6 days
100-Year Peak Duration	 115,000 15 days	 115,000 10 days

Recreation use and quality are closely tied to the water-surface elevation. At Folsom Reservoir, this relationship is based on facility design and location, the physical carrying capacity of the resource, and the values associated with the reservoir at different water-surface elevations. As the water-surface elevations are lowered, facilities become inoperable, or the facilities and resource are negatively affected for recreational use. In addition, the water surface available for recreation decreases measurably. It should be noted that areas of water depths which are not adequate for the operation of deepdraft boats, or are unsuitable or dangerous for water-dependent activities such as waterskiing and jetskiing, are still included as water-surface area.

Loss of recreational use is projected under all reoperation alternatives. The opportunity for recreation would be less during the winter when flood storage capacity is increased under the Folsom Modification Plan. The exceedence frequencies for recreational effects were evaluated based on a model analysis for 475,000 to 670,000 acre-feet. Because the frequency of effect is greatest with the fixed storage requirement, it was believed that this analysis was representative of effects most often expected. It should be noted that, on rare occasions, effects to recreation, primarily during the off-season, could be dramatically greater than those described in this section. The magnitude of the effects on recreation facilities and use described below could be greater as a result of the surface elevation of

Folsom Reservoir falling to extremely low levels. Review of the 70-year PROSIM modeling output indicates that lake elevations could fall to and stay below low levels (less than 350 feet above sea-level) for one entire off-season period.

Significance Criteria

Effects on boating, swimming, fishing and wading were considered significant if changes in flows or water temperature would result in a 10 percent reduction in recreational use and availability of recreational facilities when compared to the No-Action Plan.

Impacts

Folsom Reservoir. All boat ramps would be out of operation 1 percent of the time (5 out of 350 months) during the peak season and 2 percent of the time (12 out of 490 months) during the off-season. Boat ramp availability would be limited 31 percent of the time during the peak-use season (109 months) and 80 percent (393 months) during the off-season. Usable surface area for boating would become constrained 13 percent of the time (45 months) during the peak-use season and 37 percent (181 months) during the off-season. The lake elevation would fall below the optimal level for boat ramp availability 47 percent of the time (163 months) during the peak-use season.

Swimming and beach use areas would be inundated 28 percent of the time (94 out of 350 months). The optimal lake elevation threshold for swimming and beach use would be exceeded during the peak-use season 47 percent of the time (163 months).

The lake level at which boat ramp availability becomes constrained would be exceeded for five 2-year periods during the peak use season, the same as under the No-Action Alternative. For the off season, the threshold would be exceeded for seven 2-year periods, the same as under the No-Action Alternative.

Fishing opportunities are not expected to be adversely affected because suitable habitat for warmwater sport fish would not change substantially from that under the No-Action Alternative.

Recreation use during the peak use season for the Folsom Modification Plan is predicted to decrease by approximately 6,900 visitor-days, which represents a decrease of approximately 0.3 percent from use under the No-Action Alternative of 2.3 million user days per year.

Effects on recreation at Folsom Reservoir under the Folsom Modification Plan are considered less than significant during the peak use season because exceedence frequencies of important recreation thresholds would be similar to those under the No-Action Alternative, and differences would be within the 10 percent significance threshold; the exceedence duration of important thresholds would decrease during the peak-use season and increase

during the off-season but would fall within the 10 percent significance threshold, and peak season use would decrease slightly. Effects on recreation during the off-season are considered significant because of the reduced availability of boat launching facilities, as indicated by a 32 percent change from the No-Action Alternative.

Lower American River. Under the Folsom Modification Plan, minimum-flow impact thresholds for boating activities would be exceeded 23 percent of the time (65 out of 280 months) on the lower American River. Optimal-flow impact thresholds (<3,000 cfs) for boating activities would be exceeded 47 percent of the time (132 months). For swimming activities, impact thresholds (<1,500 cfs) would be exceeded 18 percent of the time (51 months), whereas water temperature impact thresholds (<65°F) would be exceeded 48 percent of the time (132 out of 276 months).

Temperature and flow fluctuations would result in little change in the quantity and quality of fish habitat relative to the No-Action Alternative. Because fish habitat would not be substantially affected, it is assumed that sportfishing opportunities would not change from those under the No-Action Alternative.

Effects on recreation along the lower American River under the Folsom Modification Plan are considered less than significant because the frequency with which important thresholds for swimming and boating would be exceeded would be similar to the frequency under the No-Action Alternative and temperature, and flow fluctuations are not expected to substantially change the availability of sport fish.

Shasta and Clair Engle Reservoirs. The recreation conditions would be virtually unchanged from the No-Action Alternative.

Mitigation

Reoperation under the Folsom Modification Plan could potentially cause significant adverse effects to off-season recreation at Folsom Reservoir as a result of low availability of boat-launching facilities. This impact would be reduced to a less than significant level by extending a low-water boat ramp as proposed by Reclamation and SAFCA as part of interim reoperation of Folsom Dam and Reservoir (SAFCA, 1994). If lake levels do not fall low enough to implement this measure during the period of interim reoperation, existing facilities (Granite Bay, Hobie Cove, Brown's Ravine Marina, and Dike 8) should be modified as necessary to provide continued access during low-water periods after permanent reoperation is implemented. These modifications could include the extension of boat-launching ramps, dredging of channels, and extension of access roads.

CULTURAL RESOURCES

No-Action Condition

Under the No-Action Alternative, conditions to cultural resources resulting from reservoir operation could include, but are not limited to, (1) vandalism, (2) physical destruction by waves, (3) shoreline erosion, and (4) development of a new zone of frequent wet-dry cycling (Corps, 1992b). Large fluctuations in water levels cause the formation of a very wide shoreline band in which the potential for physical destruction of resources by vandalism, wave action, and alternative submergence and emergence make preservation of sites within this zone very difficult (Clark, 1989).

Based on information from the California Historical Resources Information Center, 143 known sites in the Folsom Reservoir inundation zone could be affected under the No-Action Alternative. Additional sites that have not been identified in previous surveys also may be present. Of the 143 known sites, 35 are within 0.25 mile of designated recreation areas and are therefore subject to a higher degree of disturbance than those farther away. All the 143 known sites and any unidentified sites would continue to be subjected to effects of wave action, vandalism, alternative drying and inundation, and inadvertent damage by offroad vehicles.

Significance Criteria

For the purposes of the this analysis, impacts to cultural resources are considered significant if the affected property is a site, building, structure, or object which is recognized as culturally or historically significant based on the institutional, public, or technical criteria described in chapter 6 under Cultural Resources for the No-Action Alternative.

Impacts

Folsom Reservoir. Operation of Folsom Reservoir under the No-Action Alternative would periodically expose cultural resources along the reservoir shoreline between elevations 426 and 392 to the impacts associated with a fluctuating reservoir pool, as described above. Operational impacts do not lend themselves to quantitative analysis and, as such, are more difficult to articulate. In general, these impacts are associated with increased patrol time to control illegal vehicle access and natural and cultural resources damaged by illegal vehicle access. This access is gained by lower water-surface elevations which allow vehicles into areas formerly barricaded by water features of the reservoir. As water-surface elevations are lowered, the shoreline recedes, inlets dry up, and areas previously inaccessible are now subject to access. Most of the access is by four-wheel-drive vehicle over the dewatered lakebed. In addition to natural resource damage, historic and prehistoric cultural resources are damaged as a result of the increased access. The Folsom Modification Plan would expand the area subject to disturbance by 12 feet on an annual basis and expose resources between elevations 426 and 414 to a significantly greater risk of damage or loss.

The same number of sites would be exposed to various potential impacts under both the No-Action Alternative and the Folsom Modification Plan. The only difference is the degree of impact. The surface-water elevation in the Folsom Reservoir inundation zone tends to fluctuate more under the Folsom Modification Plan than under the No-Action Alternative. However, a review of the hydrologic modeling indicates that this impact would be minor. In general, sites at higher elevations would be exposed to the greatest levels of impact, both from wave action and from human actions.

Under 2020 demand conditions, one known site in the reservoir inundation zone would not be affected by exposure-related impacts. The remaining known sites would continue to be affected by wave action and exposure similar to the effects described under the No-Action Condition. An unknown number of additional cultural resource sites that have not been identified also could be affected in a similar manner. Implementing the Folsom Modification Plan would contribute slightly to the ongoing significant effects on cultural resources. This contribution to ongoing effects is considered significant.

Lower American River and Shasta and Clair Engle Reservoirs. The impacts on cultural resources would be unchanged from the No-Action Alternative. However, flooding in excess of the current level of protection could cause significant damage to a number of the prehistoric and historic archeological sites along the terraces of the lower American River.

Mitigation

Compliance with the National Historic Preservation Act would reduce the potentially significant impacts on Folsom Reservoir sites likely under the Folsom Modification Plan to a less-than-significant level. Toward that end, at the direction of the SHPO, a Research Design was prepared to serve as a foundation for determinations of eligibility for inclusion of Folsom Reservoir sites into the National Register of Historic Places. The research design also serves to identify additional areas for inventory. Future actions to achieve compliance with the National Historic Preservation Act call for preparing an agreement document; field work to aid in the determination of eligibility process; developing a Findings of Effects document; and preparing a treatment plan for select resources and select treatment, including stabilization of appropriate sites.

FISHERIES

No-Action Condition

Conditions for fisheries and aquatic habitat would be similar to those under the No-Action Alternative.

Significance Criteria

For purposes of evaluating the impacts of the Folsom Modification Plan on fishery conditions, it is assumed that a 10 percent exceedence criteria when compared to the No-Action Alternative would constitute a significant impact.

Impacts

Folsom Reservoir.

Black Bass Spawning and Rearing Habitat. Under the Folsom Modification Plan, differences in annual black bass spawning and rearing habitat values would range from a 7 percent decrease (140 acres) in spotted bass spawning habitat to a 19 percent increase (436 acres) relative to the No-Action Alternative. Median differences in habitat values would be 2 percent. Therefore, there would be no significant changes in black bass spawning and rearing success relative to the No-Action Alternative.

Spawning Success Of Warmwater Fish. No changes would occur in the frequency of reservoir drawdowns of 2 feet or more per month during the primary spawning months for warmwater game fish (March through July). Therefore, impacts of reservoir drawdown on the spawning success of warmwater game fish would not change relative to the No-Action Alternative.

Coldwater Fish Habitat. Average monthly reservoir storage would be reduced by 3 to 9 percent in December through March, 1 to 2 percent in May through October, and by less than 1 percent in April. Storage reductions would peak in February. Reductions in reservoir storage during winter are not expected to cause significant adverse impacts on the reservoir trout fishery because coldwater habitat is unlikely to be limiting the abundance of stocked trout, especially during the colder months when the reservoir is thermally mixed. Lower reservoir storage during winter may actually improve feeding opportunities for rainbow trout by increasing prey availability.

Lower American River.

Flow Impacts on Habitat. The frequency with which lower American River flows would meet or exceed the Hodge flows would increase by 5 percent in October through February (182 out of 350 months), 2 percent in March through June (151 out of 280 months), and 1 percent in July through September (161 out of 210 months). Chinook salmon spawning flows may improve slightly. In general, flow conditions on physical habitat in the lower American River would be similar to those under the No-Action Alternative.

Water Temperature Impacts. Water temperature impacts on lower American River fisheries resources based on an analysis of monthly water temperatures are described below. An additional analysis of daily exceedence frequencies based on the historical

relationship among reservoir storage, lower American River discharge, and maximum daily water temperatures in the lower American River was not required because the alternatives to be analyzed include operation of a temperature control device at Folsom Dam, which is expected to alter the relationship among storage, discharge, and water temperatures.

Chinook Salmon. The frequency with which monthly water temperatures would exceed optimal water temperatures for chinook salmon spawning and incubation (56 °F) in October and November would be increased by 1 to 2 percent (1 to 7 additional months) compared to the No-Action Alternative. The frequency with which temperatures at Nimbus Hatchery could exceed 56° F (based on monthly water temperatures at Nimbus Dam) would increase by 1 percent (1 additional month). Therefore, there would be no significant changes in temperature impacts on in-river and hatchery production of chinook salmon.

A 1 percent decrease to a 1 percent increase in exceedence frequencies would occur in spring relative to the chinook salmon rearing and emigration threshold, depending on distance downstream from Nimbus Dam. Therefore, water temperature impacts on chinook salmon rearing and emigration success would not change significantly relative to the No-Action Alternative.

Steelhead Trout. The frequency with which monthly water temperatures would exceed optimal water temperatures for steel head trout spawning and incubation (52°F) would decrease by 3 to 6 percent (6 to 14 fewer months).

As under the No-Action Alternative, monthly water temperatures in summer would continue to exceed the rearing threshold (60 °F) in all years. A 1 percent decrease or no change would occur in exceedence frequencies relative to the steelhead trout emigration threshold. Therefore, there would be no significant adverse impacts on the success of steelhead trout rearing and emigration.

American Shad, Striped Bass, Sacramento Splittail. No changes would occur in frequency with which monthly water temperature would exceed spawning temperature thresholds (68 °F) for American shad, striped bass, and Sacramento splittail. Therefore, water temperature for the spawning success of these species would be similar to those under the No-Action Alternative.

Flow Fluctuation Impacts. The frequency of flow reduction of 50 percent or more during the chinook salmon spawning and incubation period would remain unchanged in October through January, increase by 6 percent in November through February, and decrease by 1 percent in December through March. The frequency of 50 percent flow reduction during the steelhead trout spawning and incubation period would increase by 1 percent in January through April and by 6 percent in February through May. Therefore, redd stranding impacts were considered less than significant for steelhead trout and chinook salmon.

Potential stranding impacts on Sacramento splittail would be similar to those under the No-Action Condition. The frequency of reductions in river stage of 1 foot or more would decrease by 1 percent during the principal splittail spawning and early rearing period.

Downstream from American River. Flow and water temperature conditions on fishery resources in the lower Sacramento River would be similar to those under the No-Action Alternative. Changes in average monthly flow at Freeport ranged from a 1 percent decrease in March and April to a 3 percent increase in November.

Delta outflows and total Banks and Tracy exports for fishery resources would be similar to those under the No-Action Alternative. Average monthly Delta outflow would decrease by 1 percent in March and April and increase by 3 percent in November. Differences would be less than 1 percent in the remaining months. Changes in average Delta exports would range from a 1 percent decrease in April to a 2 percent increase in November.

Shasta Reservoir and Upper Sacramento River. Implementing the Folsom Modification Plan would have little or no effect on Shasta Reservoir fish habitat and populations. Average monthly reservoir storage differed by less than 1 percent from storage levels under the No-Action Alternative.

The frequency with which end-of-month September storage levels would meet the 1.9 monthly average flow carryover storage criterion for water temperature control in the upper Sacramento River (specified by NMFS in its 1993 biological opinion for winter-run chinook salmon) would not change. Therefore, storage-related water temperature impacts on winter-run chinook salmon spawning success would be similar to those under the No-Action Alternative.

Flows in the upper Sacramento River would be similar to flows under the No-Action Alternative. Changes in average monthly flow at Keswick Dam would be less than 1 percent. The frequency with which flows would meet the October through March minimum release criterion of 3,250 cfs at Keswick Dam would not change.

The frequency with which monthly water temperatures would exceed the chinook salmon spawning and rearing thresholds in the upper Sacramento River would slightly decrease or increase, depending on the critical spawning and incubation months for each salmon run. The frequency with which monthly water temperatures would exceed the chinook salmon rearing and emigration threshold would not change. Therefore, there are no significant temperature impacts on chinook salmon spawning and rearing success in the upper Sacramento River under the Folsom Modification Plan.

Mitigation

No significant impacts on fisheries were identified for the Folsom Modification Plan; consequently, no mitigation is required.

VEGETATION AND WILDLIFE

No-Action Condition

Conditions for vegetation and wildlife for the Folsom Modification Plan are expected to be similar to those under the No-Action Alternative.

Significance Criteria

For purposes of evaluating the impacts of the Folsom Modification Plan on vegetation and wildlife conditions, if it assumed that a 10 percent exceedence criteria based on the No-Action Alternative would constitute a significant impact. Significance criteria for vegetation and wildlife under the Folsom Modification Plan are expected to be similar to those under the No-Action Alternative.

Impacts

Folsom Reservoir. Implementation of the Folsom Modification Plan would result in no substantial changes in the acreage or condition of willow scrub vegetation in the Folsom Reservoir drawdown zone. Therefore, special-status wildlife such as migrant willow flycatchers would not experience any decrease of potential habitat. This conclusion is based on analysis of projected lake elevations indicating that lake elevations higher than 430 feet for 3 or more consecutive months during the willow growing season could be in approximately 64 percent of years (13 percent less than under the No-Action Alternative). Under the No-Action Alternative, half or more of the existing willow scrub may be eliminated by drowning when lake levels are no longer abnormally low because of prolonged drought. The amount of this expected loss could be slightly less under the Folsom Modification Plan because lake levels are above 430 feet for extended periods during substantially fewer years.

Changes in reservoir operations would have no effect on vegetation or special-status plants above the spillway elevation of Folsom Reservoir because these resources are not maintained by water in the reservoir. Also, no adverse effect to the wildlife in the area would be realized.

Implementation of the Folsom Modification Plan would result in no significant habitat or population changes in black bass or warmwater fish or coldwater fish at Folsom Reservoir relative to the No-Action Alternative. No change would occur because drawdown would not be significant enough to cause concentration of fish. Therefore, wildlife that rely on fish for prey are unlikely to experience any adverse effects under this alternative, and any impacts would be less than significant.

There would be no change in the amount of open water habitat at Folsom Reservoir relative to the No-Action Alternative. The large amount of open water that would remain in

the reservoir under this alternative would be expected to provide sufficient habitat for waterfowl, grebes, and other water birds. Migrant and resident songbirds that visit patches of willows in the drawdown zone could potentially experience an increase in habitat which could offer slight benefits to their populations.

Riparian and wetland vegetation at Lake Natoma would not be measurably affected because water levels in Lake Natoma would not change substantially under this plan. No adverse impacts to wildlife at Lake Natoma would be expected.

Lower American River. Implementation of the Folsom Modification Plan would result in no long-term net reductions in riparian plant communities or wetland vegetation along the lower American River. This conclusion is based on a comparison of mean monthly river stages by water-year type. This comparison indicated the following:

> In most year types, river stage occasionally would average up to 0.6 foot higher under this alternative than under the No-Action Alternative during some winter months, which may slightly improve ground-water recharge in the riparian zone.
>
> In below normal and dry years, river stage would average slightly lower under the Folsom Modification Plan during June through September; however, no increased drought stress on riparian forest and scrub vegetation or dewatering of freshwater marsh vegetation is expected because the average amount of river stage decline during summer months would be small, generally less than 0.2 foot. Decreased mean river stage during March and April of up to approximately 0.7 foot could facilitate increased establishment of willows in some riverbank locations.

Changes in water-surface elevations during floods are not expected to be substantially different. Small changes in water-surface elevations would not measurably affect border zone or riparian zone vegetation. No wildlife species associated with this habitat would be adversely affected.

Implementation of the Folsom Modification Plan would result in no significant reductions in freshwater marsh or riparian forest and scrub communities at the off-channel ponds on Sacramento Bar. This conclusion is based on a comparison of mean monthly river stages by water-year type and an evaluation of pond hydrology and bathymetry (appendix B of the Folsom Dam and Reservoir Permanent Reoperation Study report). This evaluation indicates that in below normal and dry years, pond levels occasionally would average slightly lower under this alternative than under the No-Action Alternative during June through September. The amount of this decrease (generally less than 0.2 foot) probably is too small to measurably reduce vegetation acreage or condition in and around the ponds. No wildlife species associated with this habitat would be adversely affected.

Impacts to wildlife along the lower American River for all habitat types is considered to be less than significant because of the lack of measurable change in habitat.

Downstream from American River. Implementation of the Folsom Modification Plan would result in no substantial hydrologic changes likely to affect riparian or wetland vegetation or special-status plants along the Sacramento River or in the Delta. This conclusion is based on Sacramento River and Delta outflow simulations indicating that changes in average monthly flow measured at Freeport and Delta outflow would decrease by 1 percent in March and April, increase by 3 percent in November, and change by less than 1 percent in remaining months. Changes in this area would not substantially affect wildlife habitats or populations.

Mitigation

No significant impacts on vegetation or wildlife were identified for the Folsom Modification Plan; consequently, no mitigation is required.

WATER QUALITY

No-Action Condition

Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. These low flows periodically result in high water temperatures that may jeopardize juvenile fish. Runoff from the portions of the lower American River area north of the river is collected and discharged into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

Significance Criteria

For purposes of this analysis, any degradation in water quality below standards established by the Regional Water Quality Control Board of EPA would constitute a significant adverse effect.

Impacts

Folsom Reservoir. Water quality problems, including low dissolved oxygen concentrations and microorganism blooms that contribute to taste and odor problems in domestic water supplies, are largely attributable to elevated water temperatures. In Folsom Reservoir, these problems are typical during the summer when storage falls below about 400,000 acre-feet and water temperatures exceed about 70 °F. The Folsom Modification Plan would not significantly increase the frequency at which these conditions would be expected. Therefore, significant adverse impacts on water quality are not anticipated.

Lower American River. Water quality in the lower American River is also affected by elevated water temperatures. However, for the reasons discussed above, the Folsom Modification Plan would not significantly increase the potential for conditions detrimental to water quality in the lower American River.

Downstream from American River. Reclamation is required under the 1994 Bay Delta Standards to maintain water-quality standards in the Delta. Compliance with the conditions in the 1994 Bay Delta Standards was an inherent assumption in the hydrologic modeling performed in connection with this SEIS/EIR. Therefore, the Folsom Modification Plan would not affect water quality in the Delta.

Shasta and Clair Engle Reservoirs. Water quality in these reservoirs would remain subject to a similar operational regime to which it has been subject to under the No-Action Condition. Therefore, the Folsom Modification Plan would not affect water quality in these reservoirs.

ENDANGERED SPECIES

No-Action Condition

A discussion of listed species which may be affected by the Folsom Modification Plan may be found in chapter 4 and appendix K. Table 4-3 lists sensitive plant and wildlife species, their scientific names, and their status.

Significance Criteria

For the purposes of this analysis, any action taken directly in connection with, or indirectly caused by, the project which would affect the continued existence of a threatened or endangered species is considered a significant adverse impact.

Impacts

Folsom Reservoir. Implementation of the Folsom Modification Plan would result in no change to sensitive species in Folsom Reservoir relative to the No-Action Alternative.

Lower American River and Downstream from American River. The Folsom Modification Plan would increase the potential for stranding chinook salmon juveniles and steelhead trout redds and juveniles as a result of increases in the frequency and magnitude of flow fluctuations in the lower American River during winter and spring (February through May). There would be no significant adverse effects.

Shasta and Clair Engle Reservoir. Implementation of the Folsom Modification Plan would result in no significant impacts to sensitive species within these areas.

Mitigation

No significant adverse effects to endangered species were identified for the Folsom Modification Plan; consequently, no mitigation is required.

VISUAL RESOURCES

No-Action Condition

The No-Action Condition is similar to the conditions under the Folsom Modification Plan.

Significance Criteria

Reduction in water-surface elevation of 10 feet or more is discernible to most of the general public, and a reduction of 15 feet or more is demonstrably negative and would be considered significant.

Impacts

Folsom Reservoir. Visual resource impacts are much greater in frequency and magnitude under the Folsom Modification Plan than under the No-Action Alternative because the average flood control space is greater. The reservoir surface would average about 12 feet lower in winter flood season.

Lower American River, and Shasta and Clair Engle Reservoirs. The impacts to visual resources in these areas would be the same as for the No-Action Alternative.

Mitigation

No feasible mitigation is available for significant visual resource impacts that would result at Folsom Reservoir under the Folsom Modification Plan.

CONSTRUCTION IMPACTS

The construction impacts of concern under the Folsom Modification Plan are those related to modifying Folsom Dam's outlet works to permit more aggressive flood control releases, strengthening portions of the dam and enlarging gates to permit increased surcharge storage, strengthening the levees along the American River to ensure greater reliability in the performance of these levees, and strengthening a portion of the east levee of the Sacramento River to optimize the level of flood protection for Natomas. Prior environmental studies

(Corps, 1991) indicate that constructing these improvements could result in short-term impacts to recreation; fish and aquatic habitat, vegetation and wildlife; water quality; air quality; transportation; noise; and esthetics. These impacts and appropriate mitigation measures to be used during construction are discussed below.

RECREATION

No-Action Condition

Folsom Reservoir. This alternative would require alteration of the spillway and outlet works to allow for an increase in design releases.

Lower American River. Earthen levees 20 to 30 feet high border much of the lower half of the American River parkway, blocking out surrounding urban development and activity. These physical barriers and extensive stands of mature riparian forest give the parkway a "wilderness in the city" quality. The Jedediah Smith Trail provides bicycle, pedestrian, and equestrian trails from Discovery Park to Folsom Reservoir and is one of the parkway's most popular features. The trail also connects with the Sacramento River Trail and Old Sacramento State Historic Park. The 23 miles of river below Nimbus Dam is included in both the State and Federal wild and scenic river systems.

Downstream from American River. Levees and stability berms along landward slopes of the east levee of the Sacramento River in Natomas would be strengthened and raised.

Significance Criteria

Impacts to recreational resources are considered significant if the project would cause substantial long-term disruption of an existing recreational activity which is recognized institutionally in the plans and policies of public agencies or private organizations, or which is identifiable based on the general popularity of the activity.

Institutional Recognition. Institutional recognition is based upon acknowledged laws, adopted plans, and other policy statements of public agencies and private organizations. The proposed recreation plan for this study takes into account the recreation plans for the City and County of Sacramento.

Public Recognition. The lower American River has traditionally been popular for a wide range of recreational activities, including rafting, fishing, boating, swimming, hiking, bicycling, and nature walks. Thus, the significance the public gives the recreation of the lower American River is an important element in judging impacts to recreation.

Impacts

Folsom Reservoir. Spillway lowering and gate modification would be accomplished by installing a watertight bulkhead or stoplog system to allow work to be done without requiring reservoir drawdown. No adverse effects would be realized.

Lower American River. During construction of the slurry wall, users of the portion of the American River bike trail on top of the levee would experience a short-term disruption. Detour routes are not readily available at some construction sites.

Downstream from American River. The levee work along the Sacramento River would not interfere with recreation associated with the Sacramento River, because the work would be done exclusively along the landward levee slope. No impacts to recreation are expected as a result of this work.

Mitigation

Mitigation for recreation impacts would include the installation of guide signs to route recreation traffic around construction areas. Portable fencing would surround the construction sites.

FISHERIES

No-Action Condition

Folsom Reservoir supports both coldwater and warmwater fisheries. However, Folsom's productivity is low because of low levels of nutrients and annual reservoir water-surface fluctuations. The DFG maintains the existing coldwater fishery, consisting of previously planted, land-locked populations of salmon and ongoing hatchery plantings of rainbow trout. These fish reproduce naturally in streams leading to the lake, but instream factors (barriers, water temperature, and fluctuating flows) limit reproduction. The reservoir supports many resident nongame fish and warmwater game fish, including large and smallmouth bass, white catfish, brown bullhead, channel catfish, and several sunfishes.

Lower American River flows are regulated by Folsom Dam. Since construction of the dam, the public has expressed concerns that insufficient minimum flows would harm the river's fishery. Although the minimum flows required for the fishery are still debated, several decisions affecting flows have been issued by the State and by the courts. State Water Resources Board Decision 893 established minimum flows from 250 cfs to 500 cfs.

Significance Criteria

For purposes of this analysis, impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory fish species, substantially diminish habitat for fish, or involve the disposal of material which could pose a hazard to fish populations.

Impacts

The construction features of this alternative would affect few of the biological resources in the area. The fishery would remain undisturbed. The major construction features and their effect on fish are as follows:

Folsom Reservoir. This alternative would require alteration of the Folsom Dam spillway and outlet works to allow for an increase in design releases. About 2,000 cubic yards of concrete would be removed and a new concrete lining installed. The main spillway would be lowered, the river outlets enlarged, and the stilling basin downstream lengthened by 50 feet. Excavated concrete would be hauled to the Sacramento County landfill at Grant Line and Kiefer Roads. No impacts to fish are anticipated because work would be restricted to the internal portions of the dam and to the spillway face.

Lower American River. The construction of 24 miles of slurry wall would not affect the fishery, since work would be done away from the river or any other water source. Based on the limited scope of the work and the temporary construction effort, impacts to fish from slurry wall construction would occur to fish.

Downstream from American River. Levee stabilization berms along the landward slopes of the east (left) levee of the Sacramento River in Natomas would be strengthened and raised. The levee work along the Sacramento River would not interfere with the Sacramento River, as the work would be done exclusively along the landward levee slope. Therefore, no fishery impacts would occur.

Mitigation

Since the construction impacts to fish are not significant, no mitigation is needed outside the normal precautions taken during construction to limit runoff, dust, and construction traffic. These conditions are considered under separate sections of this report and would be minor.

VEGETATION AND WILDLIFE

No-Action Condition

Folsom Reservoir. The land around the perimeter of Folsom Reservoir supports two vegetation cover types, live oak woodland and savanna-grassland. The savanna-grassland grows primarily at the southern end of the reservoir, while live oak woodland, with tree canopy frequently exceeding 30 percent cover, grows in the upslope areas surrounding most of the reservoir. Although grassland species comprise the dominant ground cover in both cover types, the live oak woodland includes a substantial midstory shrub layer. The most dramatic land feature influencing vegetation, especially during the summer, is the drawdown zone around the margin of the reservoir, which is incapable of sustaining vegetation, especially woody species, because of the erratic inundation/dewatering cycles associated with normal reservoir operations.

The area around Folsom Reservoir supports an animal community characteristic of the lower Sierra Nevada western slope. The woodland and savannah-grassland habitats support birds, mammals, and reptiles, which use the area for feeding, nesting, and perching. Characteristic species are scrub jay, California quail, coyote, grey fox, kingsnake, and Pacific rattlesnake. There are fewer species of wildlife around the perimeter of Folsom Reservoir than downstream. The drawdown zone is relatively lifeless.

Lower American River. The lower American River, although highly modified over the past 150 years, supports diverse and valuable biological resources. The 24-mile-long reach encompasses about 4,800 acres of flood plain containing large areas of grasslands and pasture (1,700 acres), riparian cottonwood and oak woodland (960), herbaceous plants and riparian scrub (960), bare sand and gravel (480), and surface waters of the river and associated sloughs and dredge ponds (700) (FWS).

Downstream from American River. The landward levee slope/berm area along the east (left) levee/bank of the Sacramento River where construction is proposed supports a grassland habitat with limited wildlife resources. No fishery is in this area. Typical wildlife species include those described for the reservoir area. Riparian vegetation along the Sacramento River supports a nesting population that includes the redtail hawk, Swainson's hawk, and the great horned owl.

Significance Criteria

For purposes of this analysis, impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory wildlife species, substantially diminish habitat for wildlife, or involve the disposal of material which could pose a hazard to wildlife or plant populations.

Impacts

The construction features of this alternative would affect few of the biological resources in the area. Vegetation would be marginally affected. Wildlife would be disturbed, but would not suffer significant adverse impacts. The major construction features and their effect on vegetation and wildlife are as follows:

Folsom Reservoir. This alternative would require alteration of the Folsom Dam spillway and outlet works to allow for an increase in design releases. About 2,000 cubic yards of concrete would be removed and a new concrete lining installed. The main spillway would be lowered, the river outlets enlarged, and the stilling basin downstream lengthened by 50 feet. Excavated concrete would be hauled to the Sacramento County landfill at Grant Line and Kiefer Roads. Wildlife would not suffer any losses or disturbance because the work takes place on the existing dam structures.

Lower American River. The construction of 24 miles of seepage cutoff walls would cause minimal impact to scattered grass areas along the fringes of the levee crown. The operation of construction equipment could cause a short-term disturbance to wildlife. Based on the limited scope of the work and the temporary construction effort, impacts from seepage wall construction to vegetation or wildlife would not be significant.

Downstream from American River. Levees along the landward slopes of the east (left) levee of the Sacramento River would be strengthened and raised. The levee work along the Sacramento River would not interfere with the Sacramento River, since the work would be done exclusively along the landward levee slope. Impacts would be minor to scattered grassland areas along existing levees on the landward slope. Since the work involves construction atop existing berms, trees or any other significant vegetation would not be affected. There would be short-term disturbance to local wildlife associated with construction. A population of Swainson's hawks has historically nested in the riparian fringe along the Sacramento River adjacent to this construction area. Nesting Swainson's hawks could be affected by this construction.

Mitigation

Since the construction impacts to vegetation and wildlife are not significant, no mitigation is needed outside the normal precautions taken during construction to limit runoff, dust, and construction traffic. These conditions are considered under separate sections of this report and would be minor. Potential mitigation for impacts to nesting Swainson's hawks is discussed in the endangered species section.

ENDANGERED SPECIES

No-Action Condition

Construction of the features included in the Folsom Modification Plan would potentially affect the following Federal or State-listed threatened and endangered species: valley elderberry beetle (FT), Swainson's hawk (ST), and giant garter snake (FT, ST). The conditions in the project area which support these species have been previously described (see endangered species discussion in chapter 4 and the No-Action Alternative in chapter 6. There is suitable nesting habitat for the State-threatened Swainson's hawk in the riparian fringe associated with the Sacramento River adjacent to the project area. Nesting Swainson's hawks could be affected in this area.

Significance Criteria

For purposes of this evaluation, any action undertaken directly in connection with, or indirectly caused by, the project which would affect the continued existence of a threatened or endangered species is considered a significant adverse impact. For the threatened and endangered species potentially affected by this plan, all impacts would be significant if:

> Giant garter snake: the project directly or indirectly (1) destroys or disturbs any habitat used by the snake for nesting or breeding or (2) results in any substantial loss of foraging habitat within the study area.
>
> Swainson's hawk: the project directly or indirectly (1) disturbs an occupied nest or destroys an identified nest site in or near the project area or (2) results in any substantial loss of foraging habitat within the project area.
>
> Valley elderberry longhorn beetle: the project directly or indirectly results in the partial or complete destruction of any elderberry shrubs in the project area.

Impacts

Folsom Reservoir. Modifications to the dam face would not result in adverse impacts to any endangered species at the reservoir. The modifications could be done without lowering the surface water elevation, so no adverse impacts are expected.

Lower American River. No endangered species would be adversely affected by the alternative. Since elderberry shrubs do not grow within the slurry wall alignment, shrubs along the lower American River would not be directly affected by the placement of the slurry wall.

Downstream from American River. Swainson's hawk potentially nest near construction areas along the Sacramento River east bank levee. If active nests are near construction activity, the hawks could abandon the nests, resulting in losses to the species. Suitable nesting habitat is adjacent to the construction area. Historical nests for State-threatened Swainson's hawk have been documented in the project vicinity. Nesting Swainson's hawk could be affected in this area. Potential habitat for the giant garter snake exists in the drainage ditch adjacent to the landside levee toe. No impacts to the drainage ditch or the giant garter snake are expected. The footprint of the levee would not be increased.

Mitigation

To avoid adverse effects to the Swainson's hawk, the Corps would implement seasonal restrictions on construction activity according to DFG guidelines for mitigating adverse effects on the Swainson's hawk (DFG, 1994).

WATER QUALITY

No-Action Condition

Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. These low flows periodically result in high water temperatures that may jeopardize juvenile fish. Runoff from the portions of the lower American River area north of the river is collected and discharged into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

Significance Criteria

For the purposes of this analysis, any degradation in water quality below relevant standards established by the Regional Water Quality Control Board or EPA would constitute a significant impact.

Impacts

Folsom Reservoir. Lowering the dam spillway and increasing the objective releases from Folsom Reservoir could result in more severe sedimentation impacts in the lower American River than would be experienced under the No-Action Alternative. Again, assuming proper construction procedures were implemented, the effects of construction on water quality would be minimized.

<u>Lower American River</u>. This alternative would involve a seepage cutoff wall along the lower American River, possibly causing sediment to enter the river. Assuming proper construction procedures were implemented (for example, construction during low-flow periods, use of clean materials, and revegetation of disturbed sites) the effects of construction on water quality would be minimized. No long-term significant impairment of water quality is expected.

<u>Downstream from American River</u>. This alternative involves raising and stabilizing 12 miles of levee along the east side of Natomas. Assuming proper construction procedures were implemented (for example, construction during low-flow periods, use of clean materials, and revegetation of disturbed sites) the effects of construction on water quality would be minimized. No long-term significant impairment of water quality is expected.

Mitigation

No mitigation would be necessary because typical construction activities require the use of containment barriers and dikes to reduce sedimentation. Neither the lower American River nor Folsom Reservoir would require mitigation.

CULTURAL RESOURCES

No-Action Condition

Conditions are the same as those identified in the operational impacts section.

Significance Criteria

The significance criteria are the same as those outlined for operational impacts.

Impacts

Project construction is not expected to contribute significantly to impacts on cultural resources. Potential impacts to cultural resources as a result of implementation of the Folsom Modification Plan are described under operational impacts.

Mitigation

No mitigation is required.

AGRICULTURAL/PRIME AND UNIQUE FARMLANDS

These resources will not be affected as a result of the Folsom Modification Plan. Levees would not be placed on any lands with the above designation.

HAZARDOUS, TOXIC, AND RADIOLOGIC WASTE

There are no known HTRW sites that would be adversely affected by the Folsom Modification Plan.

TRANSPORTATION

No-Action Condition

Folsom Dam Road, a two-lane roadway, crosses the top of the dam and runs beneath the mobile crane. Reclamation allows public use of the roadway between 6 a.m. and midnight. The roadway lanes are substandard in width and have no shoulders; however, the road is one of the few crossings of the American River in the area and represents an important arterial connecting the City of Folsom and western El Dorado County to communities in northeastern Sacramento County and southern Placer County.

Significance Criteria

To determine whether project-generated traffic and transportation impacts would be significant, three criteria were used. First, where project-added traffic volumes would contribute to or degrade any peak-hour intersection level of service (level of service D or below), the project was considered to have a significant impact. Second, in instances where project traffic would create a substantial safety risk, this impact was considered significant. Third, where project vehicle weight would exceed roadbed design standards, potential impacts to road surfaces were considered significant.

Impacts

Folsom Reservoir. The roadway on top of the dam could be used by the public for the entire construction period, except for short periods during transport of materials and equipment. However, an access bridge would be constructed across the face of the main and auxiliary spillway and into the left abutment for use in moving materials, equipment, and personnel and to ease adverse effects on the dam road. Transportation delays such as those which occurred in 1995 due to gate repair would not occur.

Lower American River. The stabilization of levees along the lower American River would cause increased truck traffic on roads near the construction staging area.

Downstream from American River. The stabilization and raising of levees along the Sacramento River would result in periodic closure of Garden Highway and could cause increased truck traffic on roads near the construction staging area. Additional traffic would result during transport of borrow material to the construction sites.

Mitigation

To reduce the direct construction impacts associated with the various project alternatives in all project areas, the following measures would be implemented:

- Contractors would avoid public roads when hauling materials to construction sites. If this is not feasible, contractors would prepare a transportation plan with information on haul routes and the number of trucks per day, as well as a traffic engineering analysis indicating that potential affected intersections have adequate turning radii for oversized vehicles.

- Contractors would avoid hauling on public roads during weekday peak traffic periods, such as 6:30-9:30 a.m. and 3:30-6:30 p.m., especially in developed areas. If this is not feasible, contractors would prepare traffic engineering studies to include peak-hour capacity calculations at affected intersections along haul routes, demonstrating that acceptable levels of service would be maintained. These studies would be prepared for the Corps and would conform to appropriate local standards. Contractors would also allow pertinent agencies and concerned neighborhoods to comment on the transportation plan and traffic engineering studies. Where construction access was by local roads, residents would receive prior notification.

- Traffic on the Garden Highway would be rerouted to avoid construction areas.

AIR QUALITY

No-Action Condition

Most of the lower American River is in the Sacramento Valley Air Basin. The principal air pollutants in this area are ozone, nitrous oxides, and CO (carbon monoxide). Although ozone tends to be a regional problem dispersed over wide areas, CO problems are usually localized and result from a combination of high traffic volumes and traffic congestion. The two primary sources of air pollution in the American River area are motor vehicles and stationary industrial facilities and operations.

The Folsom Reservoir area is heavily influenced by air contaminants originating in the Sacramento region and from agricultural burning in the Sacramento Valley. Interstate 80, Highway 50, and local industries are also sources of air pollution. Air contaminants

concentrate most often when the atmosphere is stable and winds are light for long periods of time.

The Sacramento Air Quality Management Area is not expected to reach attainment for ozone or CO before the year 2000. Traffic-related hydrocarbons, nitrogen oxides, and carbon monoxide will increase and worsen the basin's nonattainment status. The primary causes will be increased auto traffic associated with increased development and land use changes in the area. Most hydrocarbon and nitrogen oxide emissions will come from vehicle trips that originate outside the City of Sacramento, primarily from people commuting and shopping and also from through traffic.

Significance Criteria

According to appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will violate any ambient air-quality standard, contribute substantially to an existing or projected air-quality violation, or expose sensitive receptors to substantial pollutant concentrations.

Significance criteria developed by the SMAQMD (Sacramento Metropolitan Air Quality Management District) and by the EPA were used in determining the significance of project-related air-quality impacts. Project-related emissions were considered significant if emissions exceeded the SMAQMD's thresholds of:

- 85 pounds per day (ppd) of ROG,
- 85 ppd of NO_x, or
- 275 ppd of PM10 (SMAQMD 1994).

Also, project-related annual emissions were considered significant if emissions exceeded EPA's general conformity thresholds. Those conformity thresholds are based on the de minimis thresholds included in EPA's general conformity guidance regulation for the Sacramento area (40 CFR Part 51 Subpart W and 40 CFR Part 93 Subpart B). The threshold levels equal:

- 25 tons per year for ROG
- 25 tons per year of NO_x,
- 100 tons per year for CO, or
- 100 tons per year for PM10.

Impacts

Under the Folsom Modification Plan, emissions would be produced during modifications to Folsom Dam and from raising and strengthening levees along the lower American River and the Sacramento River. Construction of this alternative would be completed by the year 2008.

<u>Upper American River</u>. The Folsom Modification Plan would generate no emissions in the upper American River.

<u>Folsom Reservoir</u>. This plan would generate emissions in the Folsom Dam area from modifications to the spillway and outlet works. Table 7-2 summarizes emissions associated with those modifications.

<u>Lower American River</u>. This plan would generate emissions in the lower American River area as a result of levee strengthening.

<u>Downstream From American River</u>. This plan would generate emissions along the Sacramento River as a result of levee raising and strengthening.

Table 7-2 shows that emissions of ROG, NO_x, and CO would exceed the daily or annual emission thresholds established for the Sacramento area. This is considered a significant impact.

As shown in table 7-2, emissions associated with the Folsom Modification Plan exceed the tons-per-year conformity thresholds established by the EPA. Consequently, a conformity analysis must be conducted to show that this alternative would not violate the Sacramento area's State Implementation Plan.

Mitigation

The Corps will prepare a dust suppression plan and submit it to the SMAQMD for review before initiating construction activities. The plan will include as many of the following mitigation measures as are applicable to each project site:

- Cover, enclose, or water active storage piles at least twice daily;
- Cover inactive storage piles;
- Pave all haul roads;
- Cover securely or maintain at least 2 feet of freeboard on all haul trucks when transporting material;
- Water all active construction sites at least twice daily. Frequency should be based on the type of operation, soil, and wind exposure;
- Maintain the natural topography to the extent possible to eliminate the need for extensive land clearing, blasting, excavating, grading, and cutting and filling operations;

TABLE 7-2

Construction Equipment Emissions - Folsom Modification Plan

Year	Carbon Monoxide (CO)		Reactive Organic Compounds (ROG)		Nitrogen Oxides (NO_x)		Sulfur Oxides (SO_2)		Inhalable Particulate Matter (PM10)	
	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day
2000	105	918	13	115	256	2,225	28	240	37	395
2001	92	920	12	115	225	2,231	24	241	34	395
2002	117	893	13	104	268	2,068	29	219	36	128
2003	211	1,533	24	175	480	3,515	52	376	49	217
2004	211	1,533	24	175	480	3,515	52	376	49	217
2005	211	1,533	24	175	480	3,515	52	376	49	217
2006	211	1,533	24	175	480	3,515	52	376	30	217
2007	173	1,290	20	148	395	2,965	42	316	109	1,273
2008	72	573	8	67	165	1,327	18	140	95	1,171
2009	0	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0	0
Maximum	211	1,533	24	175	480	3,515	52	376	109	1,273

- Prohibit all grading activities during periods of high wind (that is, greater than 30 miles per hour);
- Apply chemical soil stabilizers on inactive construction areas (disturbed lands within construction projects that are unused for at least 4 consecutive days);
- Apply nontoxic binders (for example, latex acrylic copolymer) to exposed areas after cut and fill operations and hydroseed area;
- Plant tree windbreaks on the windward perimeter of construction projects if they are adjacent to open land;
- Plant vegetative ground cover in disturbed areas as soon as possible;
- Install wheel washers for all exiting trucks;
- Sweep streets if visible soil is carried onto adjacent public roads; and,
- Post a publicly visible sign at the project site to specify the telephone number and person to contact regarding complaints. This person shall be responsible for responding to complaints and taking corrective action with 48 hours.

Incorporate NO_x mitigation measures into construction plans:

- Require injection timing retard of 2 degrees on all diesel vehicles, where applicable;
- Install high-pressure injectors on all vehicles, where feasible;
- Encourage the use of reformulated diesel fuel;
- Use Caterpillar prechamber diesel engines (or equivalent) and properly maintain and operate;
- Electrify equipment, where feasible;
- Maintain equipment in tune with manufacturer's specifications, except as otherwise stated above;
- Install catalytic convertors on gasoline-powered equipment;
- Substitute gasoline-powered for diesel-powered equipment, where feasible; and,
- Use compressed natural gas or onsite propane mobile equipment instead of diesel-powered equipment, where feasible.

Conformity. As shown in table 7-2, emissions associated with this plan exceed the tons-per-year conformity thresholds established by EPA. Consequently, a conformity analysis must be conducted to show that this alternative would not violate the Sacramento metropolitan area's SIP. If this plan is selected a conformity analysis would be completed prior to initiating construction.

NOISE

No-Action Condition

Existing adjacent uses in the construction area include waterside recreational uses and landward-side commercial, industrial, and residential uses. The ambient background levels range from 51.1 to 61.6 dBA. Structures are within 20 to 100 feet from the seepage wall construction sites.

Significance Criteria

The significance criteria used to evaluate anticipated noise conditions are based upon project-related incremental noise increases at the construction sites. Noise from construction activities will be compared to the city's criteria for nontransportation-related noise sources. An increase in noise of 3 dB or less is typically not perceptible, while a 5 dB increase is usually perceived as being distinctly perceptible. Consideration is given to this in assessing significance.

The noise standard that would apply to each project improvement site is contained in the General Plan Noise Element for that respective jurisdiction. All respective noise elements cite 60 dBA L_{dn} as the established daytime residential noise standard. The impacts of project-generated noise were assessed through site inspections, accepted noise modeling techniques, and use of existing noise data. Site inspections identified existing noise sources and located noise-sensitive land uses in the vicinity. Noise-sensitive land uses were typically considered to be residential, educational, church, library, and health-related facilities, and significant noise sources included surface traffic, railroads, industries, and aircraft.

Noise impacts were assessed at each of the sites by comparing project-generated construction and operational noise levels, existing noise levels, and the criteria and standards contained in applicable planning documents. The criteria applicable in this case are primarily for noise-sensitive residential uses and are intended to provide a suitable environment for indoor communication and sleep.

Impacts

Folsom Reservoir. This alternative would also require alteration of the Folsom Dam spillway and outlet works to allow for an increase in design release events. To complete construction of a gate during a construction season it would require working 20 hours each day. This would require the use of materials handling and stationary source construction equipment similar to that listed in figure 7-1. These pieces of equipment can produce noise in the 70 to 88 dBA range as measured 50 feet from the noise source. In addition to these pieces of equipment, jackhammers would probably be used to break up concrete below the spillway. Jackhammers can produce noise levels of up to 90 dBA at 50 feet. Delivery truck traffic and other mobile sources would also add to construction noise at the improvement site. All sources of project construction noise would contribute a short-term noise impact to nearby sensitive receptors. This impact would be considered significant and unavoidable. The above information is based on the results of the Montgomery-Watson study for the Corps entitled "American River Flood Control Project Task 2: Lowering Folsom Spillway" (March, 1994).

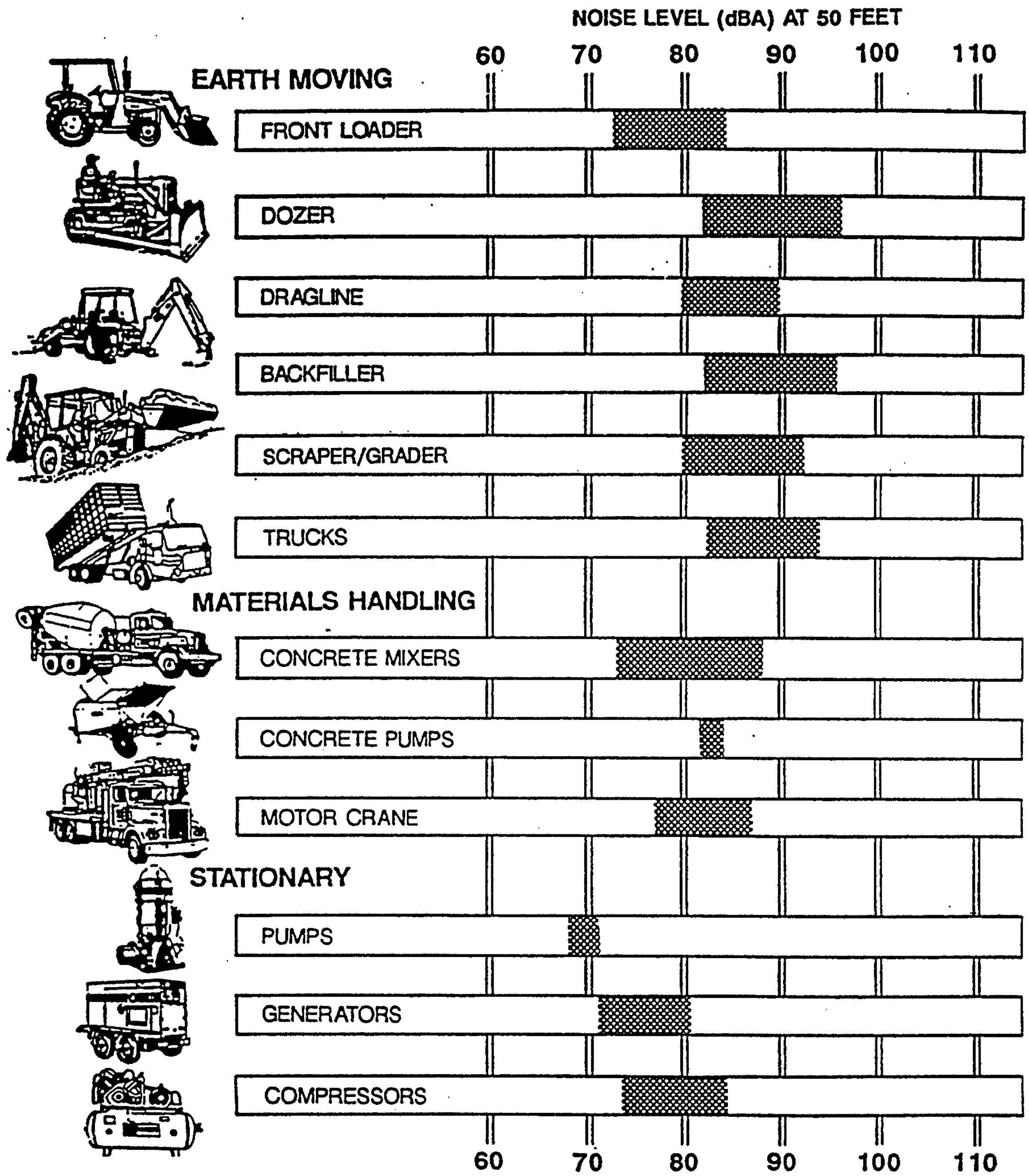
Lower American River. Construction of a seepage cutoff wall within the existing levees along both sides of the American River would generate construction noise near residential areas. These impacts would be considered short-term adverse in most areas since construction activities would be temporary and would take place during the day. Nevertheless, heavy-duty construction equipment would be expected to produce noise levels which exceed adopted standards in some areas where noise-sensitive receptors are located next to the construction site. In these cases, impacts would be considered short term but significant.

Downstream from American River. Noise impacts would be associated with raising and strengthening the levees along the Sacramento River. Heavy-equipment noise would be the major concern during levee-related and dam construction activities. Primary sources of noise in these cases would be engine exhaust, fans, transmissions, and other mechanical equipment.

Mitigation

Heavy equipment is typically fitted with mufflers and engine enclosures to allow operation in noise-sensitive areas. Thus, the source of noise may be controlled within technological limits by requiring adequate mufflers and enclosures on heavy equipment and other noise-producing tools.

When reasonably controlled, construction noise is often accepted by the public during the day (7 a.m. to 5 p.m.). People are less tolerant of noise and may complain if nonemergency construction activities continue at night. Preventing nighttime construction



Source: EPA, 1971; "Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances." NTID300.1

Figure 7-1 Construction Equipment Noise Levels

near noise-sensitive receptors could effectively reduce public concerns. The following measures are therefore recommended to reduce the project's short-term construction-related noise impacts on adjacent noise-sensitive land uses.

- Providing mufflers for all project-related heavy construction equipment and stationary noise sources (such as diesel generators). Stationary noise sources would be located at least 300 feet from occupied residences or contractors would be required to provide appropriate noise-reducing engine-housing enclosures.

- Placing equipment warmup areas, water tanks, and equipment storage areas in a central area as far away from existing residences as is feasible.

Implementing these measures for onsite construction noise mitigation would reduce the project's short-term noise impacts to the greatest extent feasible. However, because of the nearness of noise-sensitive receivers (residences), the project's short-term construction noise impacts would remain significant and unavoidable at Folsom Dam and the lower American River improvement sites.

Construction-related traffic noise could be reduced at noise-sensitive receiver locations by ensuring that all traffic complied with applicable noise emission standards. Traffic routing can be selected to minimize exposing these areas to heavy truck traffic. To reduce the project's mobile source construction noise impacts, the following measures are recommended.

- Equipping all onroad mobile construction vehicles (dump trucks) with mufflers.

- Allowing all dump truck haul trips to follow only the haul routes analyzed in this report unless the appropriate agency grants a waiver.

- Prohibiting dump truck haul trips in residential areas prior to 8 a.m. or after 6 p.m.

These mobile source noise mitigation measures would reduce project-generated mobile source noise to the greatest extent feasible. Where haul trips take place in residential neighborhoods in the lower American River area under the project alternatives, residual mobile source noise impacts would also be considered adverse but less than significant.

VISUAL IMPACTS

No-Action Condition

Construction of the features included in the Folsom Modification Plan would potentially affect the quality of visual resources in the Folsom Reservoir area, along a portion of the lower American River, and along the Sacramento River levees in west Natomas.

Significance Criteria

For a project to have a significant impact, the project or features of a project would change the visual quality of sensitive viewing components within the observable scene. A large number of viewers would notice a significant change to the character of the existing setting. Such changes may include a project feature significantly blocking a desirable viewing component or replacement of valuable environmental resources previously regarded as a visual amenity.

Impacts

Folsom Reservoir. Modification to outlets of the reservoir and the lowering of its spillway would cause visual disruption during construction. Construction equipment would be in place at various stages during the 9-year period needed to lower the spillway. Two very tall tower cranes would be visible from a great distance. Concrete trucks and pumps would be present during the entire construction period. Scaffolding would be constructed across the face of the dam and would also be in place the entire 9 years needed to lower the spillway. Other construction equipment would be at the dam during various stages of construction.

Lower American River. Construction of the seepage wall would cause short-term visual disruption along the river. Following construction, the levee would be reseeded to offset the visual impact.

Downstream from American River. Levee work along the east bank of the Sacramento River would have short-term effects to visual resources. This is not considered to be significant because the work would be constructed mainly in rural areas. Levees would be reseeded after construction.

Mitigation

Existing levees which would be improved would be seeded with an erosion-control mix of grasses and forbs as part of levee work.

CUMULATIVE IMPACTS

The cumulative impacts discussion for the Folsom Modification Plan is in chapter 10 where a combined cumulative impacts analysis compares this plans potential cumulative impacts with other ARP plans and other water resource projects for their cumulative effects on high value riparian and wetland habitats. Growth-inducing impacts are also in chapter 10.

SUMMARY OF IMPACT CONCLUSIONS AND ENVIRONMENTAL COMMITMENTS

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

The CEQA Guidelines state that any significant environmental effects which cannot be avoided if the proposal is implemented must be described. This description extends to those significant effects which can be mitigated but not reduced to a level of insignificance. Implementation of the Folsom Modification Plan would result in significant unavoidable impact to the shoreline vista of Folsom Reservoir as previously discussed in the visual resources section. The Folsom Modification Plan would result in lower water surface levels during the winter months (up to 12 feet) in about 35 years of the 70-year record. Summer water-surface levels would not be significantly lower under the Folsom Modification Plan. Based on the recreation exceedence frequency analysis lower Folsom Reservoir water-surface elevations would occur in only 5 years of the 70-year record. No feasible mitigation is available for the impact. In addition, the Folsom Modification Plan could result in the significant unavoidable cumulative impact of increasing the frequency of flow reduction and associated redd stranding during chinook salmon and steelhead trout spawning and incubation periods. These impacts may not be mitigable considering the inflexibility of seasonal flood control criteria under the Folsom Modification Plan. Construction activities at Folsom Dam would result in a significant unavoidable increase in noise during the construction season.

SIGNIFICANT IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

No significant irreversible environmental changes would result from the Folsom Modification Plan, since this alternative would not commit nonrenewable resources to uses that future generations would be unable to reverse. Folsom Reservoir operations could always be returned to the No-Action Condition should that become the prudent course of action.

SHORT-TERM USES OF THE ENVIRONMENT VS. LONG-TERM PRODUCTIVITY

The model studies comparing Folsom Reservoir operations under the 1995 and Folsom Modification Plan diagrams indicate that the Folsom Modification Plan would result in significant socioeconomic impacts to water supply, hydropower, recreation, and cultural resources, but would have only minor effects on the physical environment, principally related to periodic seasonal changes in water storage levels at Folsom Reservoir.

EFFECTS FOUND TO BE SIGNIFICANT

The summary table in chapter 1 lists the significant impact determinations.

ENVIRONMENTAL COMMITMENTS

It would be anticipated that SAFCA would provide mitigation for adverse operational effects from this plan. Environmental commitments for each of the action alternatives is as follows:

- Effects to the CVP water deliveries could be mitigated by purchasing water to meet replacement needs. Purchasing CVP supplies would reduce demands on reservoirs and allow them to refill to prereoperation levels.

- Water contractors who obtain their supplies directly from Folsom Reservoir may experience increased pumping costs due to permanent reoperation. Mitigation for this effect would be accomplished by reimbursing water agencies for anticipated pumping costs.

- Effects to hydropower generation and capacity would be mitigated by replacing the loss. This could be accomplished by purchase from another part of the grid where supply is in excess of demand.

- Effects to off-season recreational use of boat launching facilities at Folsom Reservoir would be mitigated through the extension of boat launching ramps, dredging of channels, and extension of access roads on an as-needed basis. Signs would be installed to route recreation traffic around construction areas. Portable fencing would surround the construction sites.

- Seasonal restrictions on construction activity would be in accordance with DFG guidelines and would be implemented to avoid effects to Swainson's hawk.

- SAFCA would fund a research program that would serve as a foundation for determination of eligibility for inclusion of Folsom Reservoir sites into the National Register of Historic Places. The research program would serve to identify additional areas for inventory.

- Contractors would prepare a transportation plan and traffic engineering studies if necessary. Where possible, traffic would be rerouted.

- A dust suppression plan for the construction areas would be prepared and implemented. An Air Quality Conformity Plan would be prepared and coordinated with the SMAQMD. A detailed general conformity analysis would be conducted should this plan be selected for implementation.

- To avoid or reduce the increase in ambient noise levels, the construction equipment would be equipped with appropriate mufflers, and stationary sources would be shielded. The increase in noise levels from construction and quarrying would result in significant and unavoidable effects that may not be mitigated to a less than significant level. This impact is temporary and would only last for the duration of the construction.

- No construction-related adverse effects to habitat along the lower American River are anticipated with construction of this plan. No vegetation mitigation would be required.

CHAPTER 8

ENVIRONMENTAL CONSEQUENCES
STEPPED RELEASE PLAN

Under the Stepped Release Plan, a the same flood control diagram for the operation of Folsom Dam and Reservoir as the No-Action Alternative would be adopted. In addition, the emergency spillway release diagram would be modified to reflect use of surcharge storage.

Folsom Dam. Lower the five main spillway bays 15 feet and replace the main spillway gates, enlarge the eight existing river gates, and modify the three emergency spillway gates and strengthen the core of dikes 5 and 7 and Mormom Island Dam to permit increased surcharge storage.

Lower American River. Construct 25.6 miles of slurry wall in the core of the Federal and non-Federal levees along both banks of the lower American River, apply waterside erosion protection to critical reaches of the levees, raise 14 miles of levees, construct approximately 2 miles of new floodwall and approximately 2 miles of new levees, raise the Howe Avenue and Guy West bridges, and improve existing interior drainage outfalls to accommodate higher design flows in the American River.

Downstream from American River. Lengthen the Sacramento Weir and set back the north levee of the Sacramento Bypass 1,000 feet, strengthen 52 miles of levee in the Yolo Bypass, and construct 2 miles of new levee along the west bank of the Yolo Bypass at river mile 29.9. Strengthen 60 feet of the Yolo Short Line Railroad bridge across the Yolo Bypass and lengthen the Yolo Short Line Railroad across the Sacramento Bypass by 1,000 feet and strengthen 12 miles and raise 10 miles of levees along the east bank of the Sacramento River below Verona.

In addition, the Stepped Release Plan would include constructing the following environmental restoration and recreational features:

Recreation Features. These features include developing two new parks. Gateway Park is a 25-acre park on the north bank of the American River between State Route 160 and the Union Pacific Railroad; the 10-acre 7th Street Park is on the river's south bank at the terminus of 7th Street. A third recreation feature is construction of approximately 7 miles of bicycle/pedestrian trail and related recreational facilities along the south bank of the American River.

Environmental Restoration Features. The Stepped Release Plan includes a restoration plan consisting of wetland/riparian features in two areas of the American River Parkway: the 400-acre Woodlake area extending from the mouth of the NEMDC (Natomas East Main Drainage Canal) to Cal Expo and the 122-acre Urrutia Property adjacent to Discovery Park.

Restoration in the Woodlake area would include development of a slough/wetland complex on approximately 37 acres of land owned and managed by Sacramento County and conversion of 50 acres of non-oak upland habitat to riparian and wetland plant communities. Material excavated to create this restoration feature would be used to provide fill for a portion of the levee improvements called for under the Stepped Release Plan.

Restoration on the Urrutia property would consist of creating wetland/riparian habitat on land adjacent to the 57-acre pond which dominates the site. This pond has been excavated over time as part of mining on the property. Restoration would involve excavation and fill along the northern edge of the pond to create a series of shallow shelves extending from the water's edge along a gently sloping berm to adjacent high ground. These shelves would support an assemblage of emergent marsh habitat, and the sloping berm would be planted with riparian vegetation.

OPERATIONAL IMPACTS

It is expected that under the Stepped Release Plan, the 1993 agreement (Agreement) between SAFCA and Reclamation would be indefinitely extended. For purposes of this SEIS/EIR, it is assumed that, by virtue of this extension, the operation of Folsom Reservoir and the other CVP facilities north of the Delta would be permanently modified, as necessary, to meet the requirements of the flood control diagram (1993 Diagram) contained in the Agreement.

The No-Action ("permanent reoperation") Model incorporates these demand assumptions, but adjusts CVP operations to comply with the 1993 Diagram. The No-Action Alternative is in turn used as the basis for evaluating the adverse operational impacts associated with the Stepped Release Plan.

The operational impacts of concern are those related to the adjustments in CVP operations that would be needed to accommodate the requirements of the Stepped Release Plan flood control diagram. These impacts, which include water supply, hydropower, recreation, and cultural resources, are the same as those described in the No-Action Alternative.

RECREATION

Lower American River

Table 8-1 compares the flood control release schedules for the No-Action Alternative and Stepped Release Plan for a series of selected flood events. This comparison shows that releases from Folsom would be higher under the Stepped Release Plan for events ranging in annual frequency from about 1/5 to 1/100.

These higher releases would increase downstream water-surface elevations, potentially damaging recreational facilities and related resources in the lower American River. However, the comparative differences in flow rates for the more frequent flood events are small. Under the No-Action Alternative, even the more frequent events would produce flow rates large enough to fully inundate the floodway. Thus, the higher releases under the Stepped Release Plan would raise water-surface elevations only in circumstances when recreation facilities in the lower American River would otherwise have been flooded; accordingly, the Stepped Release Plan would not result in any significant damages to recreational facilities when compared to the No-Action Alternative.

FISH, VEGETATION, AND WILDLIFE

Lower American River

Reservoir operation during flood events under the Stepped Release Plan would not significantly affect fish, vegetation, and wildlife resources. The Stepped Release Plan would require higher outflows from Folsom than would otherwise be required under the No-Action Alternative (as shown in table 8-1), under a selected range of flood events. However, these increases would occur only in circumstances when the floodway would otherwise be fully inundated. There would be no appreciable increase in the acreage subject to inundation or corresponding reduction in refugia.

WATER QUALITY

Folsom Reservoir. Water-quality problems, including low dissolved oxygen concentrations and microorganism blooms that contribute to taste and odor problems in domestic water supplies, are largely attributable to elevated water temperatures. In Folsom Reservoir, these problems are typical during the summer when storage falls below about 400,000 acre-feet and water temperatures exceed about 70 °F. The Stepped Release Plan would not significantly increase the frequency at which these conditions would be expected. Therefore, significant adverse impacts on water quality are not anticipated.

Lower American River. Water quality in the lower American River is also affected by elevated water temperatures. However, for the reasons discussed above, the Stepped

Release Plan would not significantly increase the potential for conditions detrimental to water quality in the lower American River.

TABLE 8-1

Comparison of Projected Peak Out Flows from Folsom Dam for Selected Flood Events

	Alternative	
	No-Action Alternative 400/670 115,000 cfs (objective release)	Stepped Release Plan 400/670 145/180 cfs (objective release)
5-Year Peak Duration ≥ 25,000	60,000 3 days	75,000 2.3 days
10-Year Peak Duration ≥ 25,000	90,000 4 days	115,000 3.8 days
20-Year Peak Duration ≥ 25,000	115,000 5.5 days	145,000 5.4 days
50-Year Peak Duration ≥ 25,000	115,000 10 days	145,000 7.1 days
100-Year Peak Duration ≥ 25,000	115,000 15 days	145,000 10 days

Upper American River. Water quality in the upper American River would be unaffected by implementation of the Stepped Release Plan.

Downstream from American River. Reclamation is required under the 1994 Bay-Delta Standards to maintain water-quality standards in the Delta. Compliance with these conditions was an inherent assumption in the hydrologic modeling performed in connection with this FSEIS/EIR. Therefore, the Stepped Release Plan would not affect water quality in the Delta.

Shasta and Clair Engle Reservoirs. Water quality in Clair Engle Reservoir would remain subject to the same operational regimes which it has been subjected to under the No-Action Alternative; the Stepped Release Plan would not affect water quality in these reservoirs.

CONSTRUCTION IMPACTS

The improvements required under the Stepped Release Plan for Folsom Dam and the east levee of the Sacramento River in Natomas are the same as those evaluated for the Folsom Modification Plan. The impacts and required mitigation associated with construction of these improvements are discussed in detail in chapter 7. Accordingly, the following discussion focuses on the construction impacts associated with raising and strengthening portions of the Federal and non-Federal levees and constructing new levees and floodwalls in the lower American River; modifying interior drainage and water intake facilities in the American River flood plain, raising the Howe Avenue and Guy West bridges, and constructing closure structures where the Union Pacific Rail Road traverses the Federal levees in the lower American River; lengthening the Sacramento Weir and Bypass; and substantially improving the levees in the Yolo Bypass and sloughs. The short- and long-term impacts associated with constructing these improvements would include temporary and permanent losses of fish and wildlife habitat, including habitat considered essential to the maintenance of Federal and State-listed threatened and endangered species, reductions in water and air quality, potential destruction of cultural resources, loss of farmland, increased noise and traffic, disruption of recreation, and impairment of visual resources. The following discussion evaluates the significance of these impacts and, where appropriate, identifies mitigation measures to reduce significant and potentially significant impacts to a "less than significant" level.

RECREATION

No-Action Condition

Earthen levees 20 to 30 feet high border much of the lower half of the parkway and block out surrounding urban development and activity. These physical barriers and extensive stands of mature riparian forest give the parkway a "wilderness in the city" quality. The Jedediah Smith Trail provides bicycle, pedestrian, and equestrian trails from Discovery Park to Folsom Reservoir and is one of the parkway's most popular features. The trail also connects with the Sacramento River Trail and Old Sacramento State Historic Park. The 23 miles of river below Nimbus Dam is included in both the State and Federal wild and scenic river systems. The lower American River is a major site for recreational boating, including rafting, kayaking, and canoeing. Swimming and wading are other popular water-dependent activities.

Significance Criteria

Impacts to recreational resources are considered significant if the project would cause a substantial long-term disruption of any recreational activity which is recognized institutionally in the plans and policies of public agencies or private organizations, or which is identifiable based on the general popularity of the activity.

Institutional Recognition. Institutional recognition is based upon acknowledged laws, adopted plans, and other policy statements of public agencies and private organizations. The proposed recreation plan for this study takes into account the recreation plans for the City and County of Sacramento.

Public Recognition. The lower American River has traditionally been popular for a wide range of recreational activities, including rafting, fishing, boating, swimming, hiking, bicycling, and nature walks. Thus, the significance the public gives the recreation of the lower American River is an important element in judging impacts to recreation.

Impacts

Lower American River. Under the Stepped Release Plan, construction of project improvements would temporarily adversely affect recreation uses in the American River Parkway by restricting access to existing recreational facilities, including parking facilities. These restrictions would be necessary because of construction and modification of the levee system and raising of the Howe Avenue and Guy West bridges. Improvements to the levee system would restrict access because parking lots within the parkway would be used as staging areas for construction equipment. Raising the Howe Avenue and Guy West bridges would affect access because both bridges are used for bicycle travel, and portions of the Jedediah Smith Trail would be closed or rerouted during construction. Because the levee construction will take approximately 4 years, these impacts are considered temporary but significant.

Levee modification should not affect the designation of the lower American River as a recreation river under the Wild and Scenic Rivers Act because construction would be restricted to the levees themselves. No construction is proposed for the parkway interior, so the visual character of the area would not change.

Recreation use will be affected by the raising of the Howe Avenue bridge and the Guy West bridge. Both bridges are used for bicycle travel; closing the Guy west pedestrian bridge would affect bicycling the most. Portions of the Jedediah Smith Trail in the parkway near the bridge approaches would be closed or rerouted during construction work on the bridges.

Construction of the two new parks should not significantly affect recreation use, as this area is not currently an easily accessible site. The impact to recreational enjoyment from vegetative loss due to construction would be minimal because park designs avoid vegetative impacts except to grassland areas. In addition, the presence of agricultural fields at the Gateway Park site would allow parking areas to be constructed without destroying native cover.

Construction of a bicycle trail near Richards Boulevard and Gateway Park would not significantly affect existing recreation activities because the proposed facilities are not within

an easily accessible area of the parkway. Providing additional recreation facilities is considered a beneficial impact of the project.

The spillway would be lowered and the gates modified by installing a watertight bulkhead or stoplog system to allow work to be done without requiring the reservoir to be maintained below the new spillway crest. This would lessen impacts to recreational uses at Folsom Reservoir.

Operation of Folsom Dam would not alter flow patterns during nonflood periods in the lower American River. As under the No-Action Alternative, in general, flows would continue to be higher in the late fall, winter, and early spring when Folsom Reservoir releases maintained the required flood space. Flows would be somewhat less in the late spring when flows are decreased to allow Folsom Reservoir to fill. The principal water-dependent recreation activities affected by these altered flows would be boating (including rafting, kayaking, and canoeing), swimming, and wading.

Levee modifications along the lower American River (levee raising, slurry walls, new levees) would allow increasing the objective release to 180,000 cfs over the existing 115,000 cfs release during extreme storms. This increase in flow would not cause an increase in damages to the trail system over damages experienced under the No-Action Alternative, since the trails are under water with the No-Action Alternative at 115,000 cfs.

Construction of the slurry wall would disrupt trail use. Use of staging areas by construction equipment (including parking lots) would affect parkway access. The levee modification work would extend over a 3-year construction period, but would have little adverse effect to recreation use, since recreationists would be routed around the construction sites.

Vegetation loss due to levee raising and slurry wall construction would be restricted to grassland areas which would be replaced as part of the construction contract. Levee revetment would remove grasses and the few trees on or very near the levee face. After the revetment is placed, the area would be covered with soil and hydroseeded, so there would be no esthetic impacts to recreation. The loss of substantial vegetation, such as oak woodland and riparian forest, would be restricted primarily to the new levee construction sites beginning upstream from river mile 15 on the left bank. These new levees would be constructed away from the trail system, so recreation use of the trails would not be affected.

Folsom Reservoir. There would be no construction impacts to recreation in the Folsom Reservoir area.

Mitigation

Lower American River. Potentially significant impacts on recreation associated with loss of access to the bicycle trail could be reduced to a less than significant level by routing recreation traffic around construction sites. Alternate routes would be established prior to

construction and should be clearly marked. In the event alternate routes cannot be established within the American River Parkway, public notification would be made prior to trail closure. The notification should include an estimate of the duration of trail closure and suggest alternative routes of travel outside the parkway.

Impacts associated with loss of access to parking facilities within the parkway could be mitigated by providing notification prior to closure and directing recreationists to other parking areas along the parkway.

<u>Downstream from American River</u>. Project construction in the lower Sacramento River area would take place at sites where there is little, if any, recreation use. Thus, no significant impacts to recreation would result, and no mitigation is required.

In conclusion, bicycle trail use impacts would be mitigated by routing recreationists around construction sites, notifying them of parking lot and bridge closures and, suggesting alternative parking areas.

LOWER AMERICAN RIVER RECREATION PLAN

The Stepped Release Plan includes construction of the following lower American River facilities: a bicycle bridge over the flood gates across Del Paso Boulevard; two day-use parks with associated boat launch, fishing pier, and parking facilities for cars and boat trailers; and new trails for bicycle, interpretive, and equestrian use.

- **Gateway Park**

The 25-acre Gateway Park would be along the right bank of the American River between State Route 160 and the Union Pacific Railroad tracks. The primary purpose of the park would be for increased water-related and water-dependent recreation. Environmental restoration features for enhancing the outdoor quality of the park would also be added during the park planning and design phase.

- **7th Street Park**

A 10-acre park would be located at the northern terminus of 7th Street adjacent to the American River Parkway. This will be a neighborhood park with playground equipment and river access to connect downtown Sacramento with the parkway.

- **New Trails**

The new trail extends the bicycle trail along the south side of the American River linking Tiscornia Park with Sacramento State University. Other smaller trails would be constructed for interpretive use and hiking.

After high flows, recreational use of trails and parks would be interrupted until repairs were made or cleanup completed. Low-lying portions of the bicycle trail that are prone to wash out at high flows would be particularly affected. Some vegetation would also be altered due to higher flows affecting, at least temporarily, the esthetic value of the riverine environment to recreationists.

FISHERIES

No-Action Condition

Lower American River. The aquatic resources supporting the fishery in the lower American River are considered to be only marginal for anadromous fish production, especially during low-flow years.

Increased water temperature, decreased water quality, reductions in the quantity and quality of spawning gravel, and a decline in hatchery production contribute to this potential reduction of the anadromous fishery resource.

Fall-run chinook salmon continue to be the primary species of management concern in the lower American River. This reflects the consensus reached by participants in Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge Decision)—a consensus which included as management priorities ". . . maximize the in-river production (that is, spawning, juvenile survival) of chinook salmon in the Lower American River" and ". . . maximize the in-river production of steelhead trout to the extent that it does not interfere with chinook salmon management." However, because NMFS received a petition on February 14, 1994, to list steelhead trout throughout its range in Washington, Idaho, Oregon, and California, the issue of management priorities in the lower American River merits additional discussion.

High water temperature during summer and fall is the environmental factor that is the most limiting to natural production of steelhead trout in the lower American River (Snider and Gerstung, 1986; DFG, 1991c). Historically, steelhead trout migrated upstream to their primary spawning and rearing areas in the upper forks of the American River and its tributaries. In these upper reaches of the American River system, juvenile steelhead trout reared for at least 1 year before migrating downstream to the Pacific Ocean. Cool water temperatures in the upper reaches of the system made this extended rearing component of their life history possible. Today, the historical spawning and rearing areas are inaccessible to steelhead trout, and, due to dam construction, spawning and rearing in the American River system is restricted to the lower American River—an area subjected to elevated water temperatures. Consequently, it is believed that few juvenile steelhead trout survive through the summer and fall (DFG, 1991c).

In addition to the river itself, high water temperatures at the Nimbus Fish Hatchery during late summer and fall are problematic for rearing steelhead trout, even during good

water years. High water temperatures promote the growth of disease organisms. Treatments for these diseases are expensive and contribute significantly to the cost and ineffectiveness of raising steelhead trout to yearling size (DFG, 1991c). Currently, modernization plans for the hatchery do not address the problems of high water temperatures during summer and fall at the hatchery. There are no formal plans or processes under way to resolve the problem of high water temperatures (DFG, 1991c).

Folsom Reservoir. Folsom Reservoir operations under the No-Action Alternative adversely affect resident warmwater species in two ways. First, the water-surface elevation in Folsom Reservoir is reduced by an average of 39.3 feet between June and September, a critical time in year-class development. Such drawdowns eliminate an average of 2,567 surface acres of water (25.6 percent of total), much of which is in sheltered coves containing flooded terrestrial vegetation. This loss of juvenile rearing habitat resulting from summer drawdown is thought to have the greatest negative effect on annual production of fish in Folsom Reservoir (D. Lee, DFG pers. comm. 1994). Second, fluctuations in water levels cause dewatering and flooding of nests and reduce the spawning success. As a result, annual production of bass, sunfish, crappie, bullhead, and catfish is low, and the population of these species tends to be marginal compared to those found in similar natural reservoirs that do not suffer such wide fluctuations in water level.

Upper Sacramento River. NMFS has determined that a daily average water temperature of less than or equal to 56 °F is required in the Sacramento River between Keswick Dam and Bend Bridge from April 15 through September 30 to protect winter-run chinook salmon spawning and incubation. NMFS, in its 1993 biological opinion, specified a minimum flow release criteria for October through March of 3,250 cfs at Keswick Dam.

Significance Criteria

For purposes of this evaluation, fisheries impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory fish, substantially diminish habitat for fish, or involve discharges of material which pose a hazard to fish.

Impacts

Lower American River. Raising the Howe Avenue and Guy West bridges would not require dredging. Therefore, discharge of material posing a hazard to fish in the area would be minimal. Bridge raising would require modification to 20 existing piers. A construction platform would be placed in the water near the piers. During construction, concrete and aggregate could be spilled into the river. The accidental discharge of these construction materials and sediments into the river could cause temporary short-term impacts to the fishery due to increased turbidity. This impact is considered potentially significant.

The pump stations at the mouth of the Mayhew Drain and Boyd Station would be constructed during the summer, when flows are minimal. Few, if any, fish are resident in

these side channels during low summer flows. Therefore, impacts on fish in the side channels would be minimal. Occasionally, fish (sucker, sunfish, and mosquitofish) become stranded in these side channels due to rapid flow fluctuations. A benefit of the pumping plants would be to act as a barrier to prevent fish from entering the side channels.

Mitigation

Lower American River. Potentially significant impacts resulting from increased turbidity and possible spawning area siltation could be mitigated to a less than significant level by requiring that construction sites along the parkway be fully contained by barriers and dikes to reduce any chance that sediment or fluid from construction machinery fluid enter the waterway.

Downstream from American River. Significant impacts on 51 acres of seasonal wetland/marsh habitat could be reduced to a less than significant level by restoring up to 56 acres of seasonal wetland/marsh habitat on Liberty Island in accordance with HEP recommendations.

VEGETATION AND WILDLIFE

No-Action Condition

The vegetative habitats of the lower American and Sacramento Rivers are influenced by the physical constraints of the levee system. The vegetation within the lower American River corridor consists of grassland, emergent freshwater marsh, seasonal wetlands, riparian scrub-shrub, upland herbaceous, and oak woodland. Vegetation is generally confined within the boundaries of the levee system and in most areas is limited to a narrow band between the levees and the river. Typical wildlife associated with this habitat are raccoon, wild turkeys, mink, deer, yellow warblers, and rufous-sided towhees.

Significance Criteria

For purposes of this analysis, impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory wildlife species, substantially diminish habitat for wildlife plants, or involve the disposal of material which could pose a hazard to wildlife or plant populations.

Impacts

Lower American River. The levee modifications required under the Stepped Release Plan, including slurry walls, new levee construction, levee raising, new floodwalls, and levee erosion protection, would result in significant losses of vegetation in the lower American River area. Borrow areas for this work would be a site near Cordova Park, river mile 15, and at three locations south of Highway 50 adjoining existing commercial mining areas. The

three sites outside the parkway are already in areas devoid of vegetation, thus eliminating any need for habitat mitigation. The Cordova Park borrow site is slated for use as an area to compensate oak impacts, so there would be no need to separately mitigate any upland herbaceous habitat that may have been destroyed during borrow activity (figure 8-1).

Table 8-2 shows, by construction feature, the habitat loss due to the levee modifications. The loss of these riparian, scrub-shrub, and oak habitats would cause the wildlife species relying on these habitats to be displaced, since their foraging and nesting areas would be destroyed. This is considered to be a significant impact. Impacts to wildlife as a result of the loss of the grasslands would be insignificant because this loss would be temporary and short term. Grasslands would be replaced onsite as part of the reseeding required for construction contracts.

TABLE 8-2

Habitat Loss by Construction Feature - Lower American River

Habitat Types	Construction Impact Acreage						
	Levee Raising	Revetment	Flood wall	Slurry Wall	Staging & Borrow Areas	New Levee	Total
Riparian Forest	11.33	1.22	1.58	-	-	5.29	19.42
Riparian Shrub	2.94	-	-	-	.04	.73	3.71
Oak Woodland	3.79	.65	.44	-	-	9.23	14.11
TOTAL	18.06	1.87	2.02	-	.04	15.25	37.24

(FWS 1995)

The impacts to vegetation due to construction of the new parks would be minimal (35 acres of mostly agricultural land) because park designs avoid significant vegetative impacts. In addition, the presence of agricultural fields at the Gateway Park site would allow parking areas to be constructed without destroying native cover.

Folsom Reservoir. This alternative would require alteration of the Folsom Dam spillway and outlet works to allow for an increase in design releases. About 2,000 cubic yards of concrete would be removed and a new concrete lining installed. The main spillway would be lowered, the river outlets enlarged, and the stilling basin downstream lengthened by 50 feet. Excavated concrete would be hauled to the Sacramento County landfill at Grant Line and Kiefer Roads. Wildlife would not suffer any losses or disturbance because the work takes place on the existing dam structures.

Downstream from American River. Construction of the project improvements required under the Stepped Release Plan along the lower Sacramento River area would result

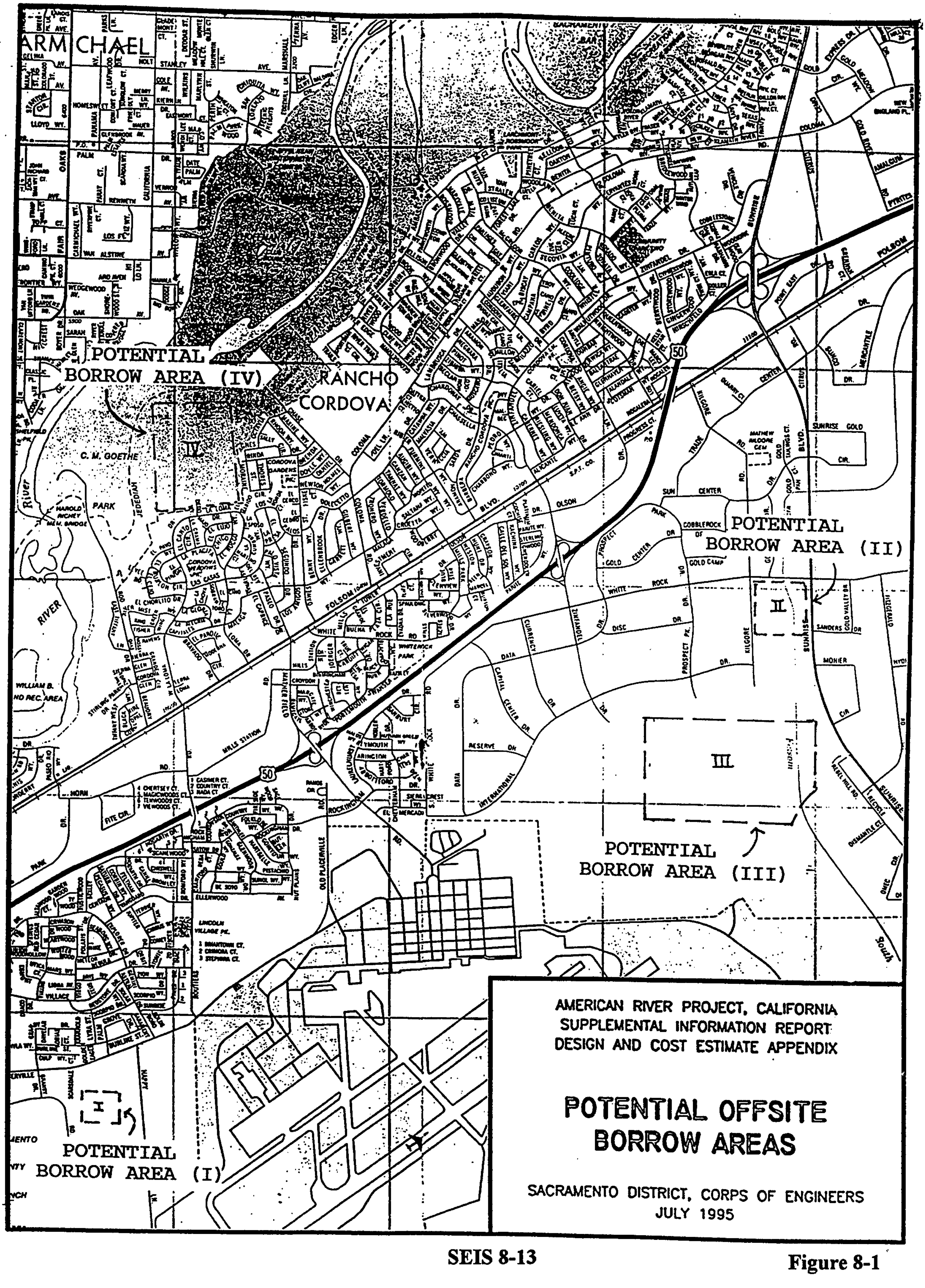

POTENTIAL
BORROW AREA (IV)
RANCHO
CORDOVA
C. M. GOETHE
PARK
POTENTIAL
BORROW AREA (II)
POTENTIAL
BORROW AREA (III)
POTENTIAL
BORROW AREA (I)
AMERICAN RIVER PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT
DESIGN AND COST ESTIMATE APPENDIX
POTENTIAL OFFSITE
BORROW AREAS
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
JULY 1995

Figure 8-1

in significant losses to vegetation. These losses would in turn significantly affect the wildlife species dependent on the affected vegetation. Table 8-3 shows the impacts by construction feature and habitat type. Levee material excavation would cause loss of upland herbaceous habitats at various borrow sites (figure 8-2). The borrow sites in this area include the Cache Creek settling basin and a West Sacramento site; for levee work along the sloughs in the Delta, sites include one north of Rio Vista along the west bank of the Sacramento River and another, Decker Island, south of Rio Vista near the east bank of the Sacramento River.

Mitigation

Lower American River. An agricultural field and a borrow site (currently used for agriculture) are proposed for use as mitigation areas along the lower American River. The first site is an agricultural field at river mile 3.7 on the north (right) bank of lower American River. This is called the Woodlake area and would be the site for mitigating riparian forest and riparian shrub habitat. The site totals 38 acres (figure 8-3). This portion of the Woodlake area is the most suitable site for mitigation because the site (1) is relatively free from human disturbance, (2) is surrounded on three sides by a seasonal slough and water sources, (3) is free from transmission towers and powerlines, (4) likely has suitable soils for riparian plantings, (5) is situated among riparian forest habitat, and (6) is free from roadways. Other portions of the Woodlake site were discounted due to their location adjacent to areas of human disturbance and close to major roadways, or the sites had transmission towers passing through. This last consideration is important due to the restrictions by the Western Area Power Administration that areas around its transmission towers remain clear of vegetation to allow routine maintenance of the tower and eliminate any chance of vegetation contacting the transmission lines. Work at the potential mitigation site includes recontouring land surfaces to maximize habitat diversity, and planting native plant species.

The Cordova Park site has been proposed for all oak-woodland mitigation (figure 8-4). The site would be used first as a borrow site supplying material that would be used for levee work along the upper portion of the lower American River, then for mitigation. The 75-acre site is near river mile 15. Excavation of this borrow site would allow the mitigation plantings to be closer to the water table; however, to ensure topsoil is sufficient for planting success, the topsoil will be removed and stockpiled for later use as a planting medium. If topsoil is insufficient, additional topsoil would need to be brought in.

This site may require land surface recontouring, replanting native oak species, and irrigating to help establish the oaks.

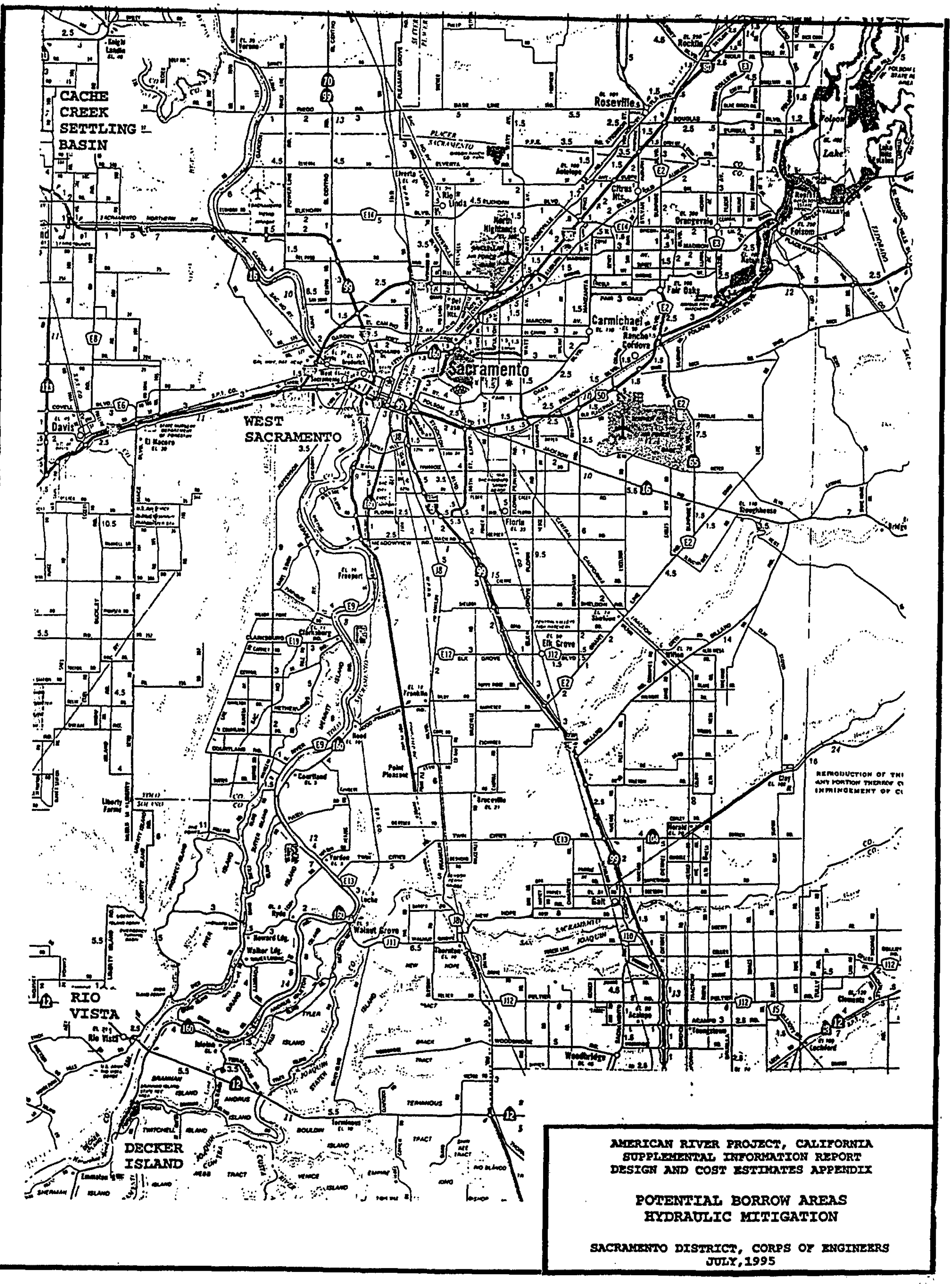
Folsom Reservoir. Since there are no construction impacts to vegetation and wildlife in Folsom reservoir, no mitigation is required for this portion of the project.to riparian and wetland habitats from work along the Delta sloughs and Sacramento

TABLE 8-3

Habitat Loss By Construction Feature - Area Downstream From American River

	Construction Impact Acreage									
HABITAT TYPE	Levee Raising	Landside Stability Berm	Stability Berm Raising	Waterside Slope Protection	Landside Slope Protection[1]	Ditch Relocation	Levee Reconstruction	Sacramento Bypass Extension	Borrow Sites	TOTAL
Riparian forest	0.96[2]	0.46	-	10.60	1.21	-	-	-	5.42	18.65
Riparian shrub	2.67	6.39	-	4.54	-	-	0.79	-	31.09	45.48
Oak woodland	-	-	-	-	-	-	-	5.15		5.15
Emergent Marsh	16.10	24.87	-	0.60	1.21	-	0.12	-	-	42.90
Permanents easonal wetlands	-	2.26	-	-	4.29	1.79	-	-	-	8.34
TOTAL	19.73	33.98	0	15.74	6.71	1.79	0.91	5.15	36.51	120.52

[1]For construction involving both landside stability berm and landside slope protection features, acreage impacts were included under the slope protection column only, as these impacts would be permanent. The overlay in construction impact for the two features includes 0.1 acre of riparian forest, 18.46 acres of upland herbaceous and 1.2 acres of emergent marsh habitat.
[2]This figure includes individual trees removed due to levee raising activities.



AMERICAN RIVER PROJECT, CALIFORNIA
SUPPLEMENTAL INFORMATION REPORT
DESIGN AND COST ESTIMATES APPENDIX

POTENTIAL BORROW AREAS
HYDRAULIC MITIGATION

SACRAMENTO DISTRICT, CORPS OF ENGINEERS
JULY, 1995

Figure 8-2

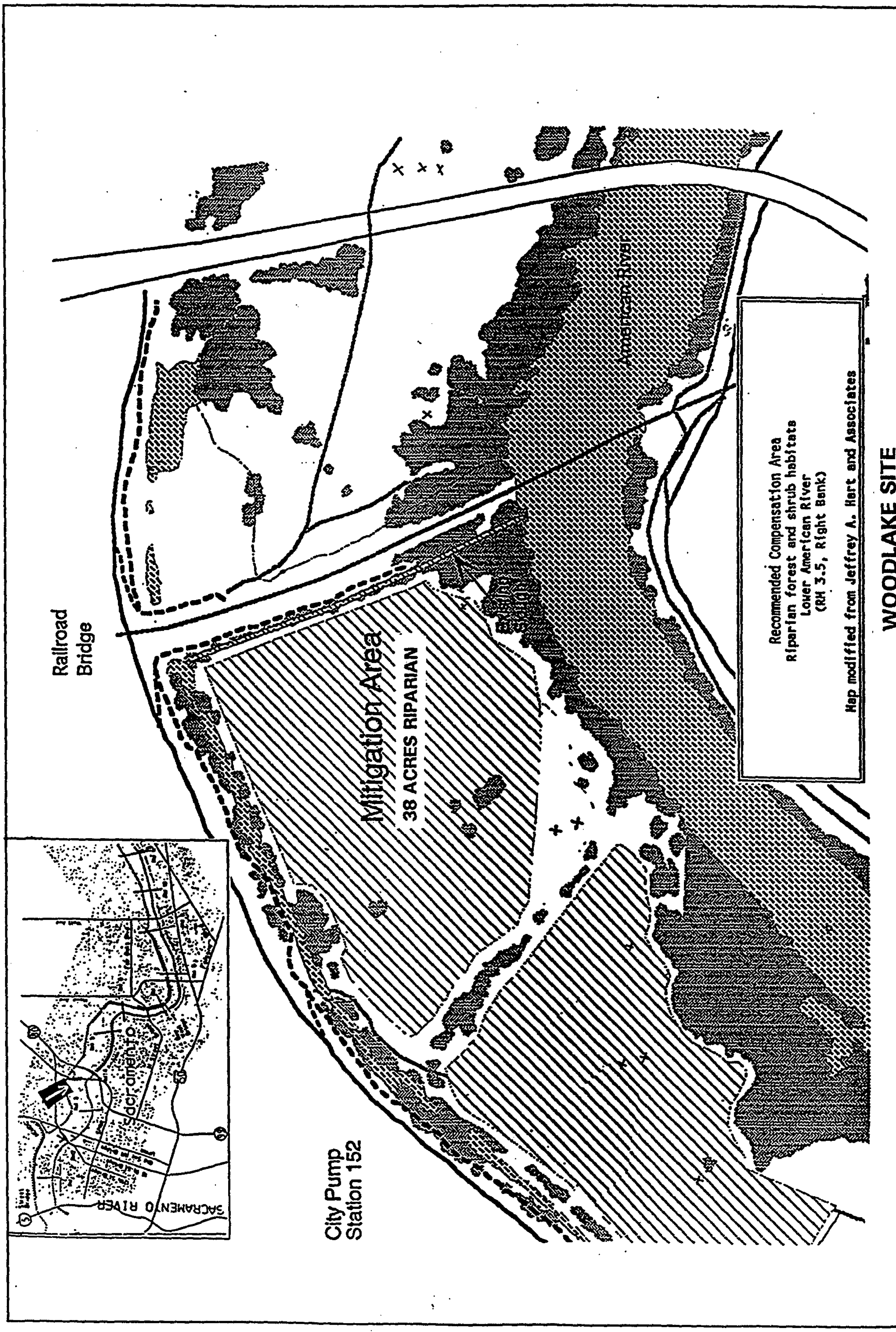

Railroad Bridge
Mitigation Area
38 ACRES RIPARIAN
American River
City Pump Station 152
SACRAMENTO RIVER
Recommended Compensation Area
Riparian forest and shrub habitats
Lower American River
(RM 3.5, Right Bank)
Map modified from Jeffrey A. Hart and Associates
WOODLAKE SITE

Figure 8-3

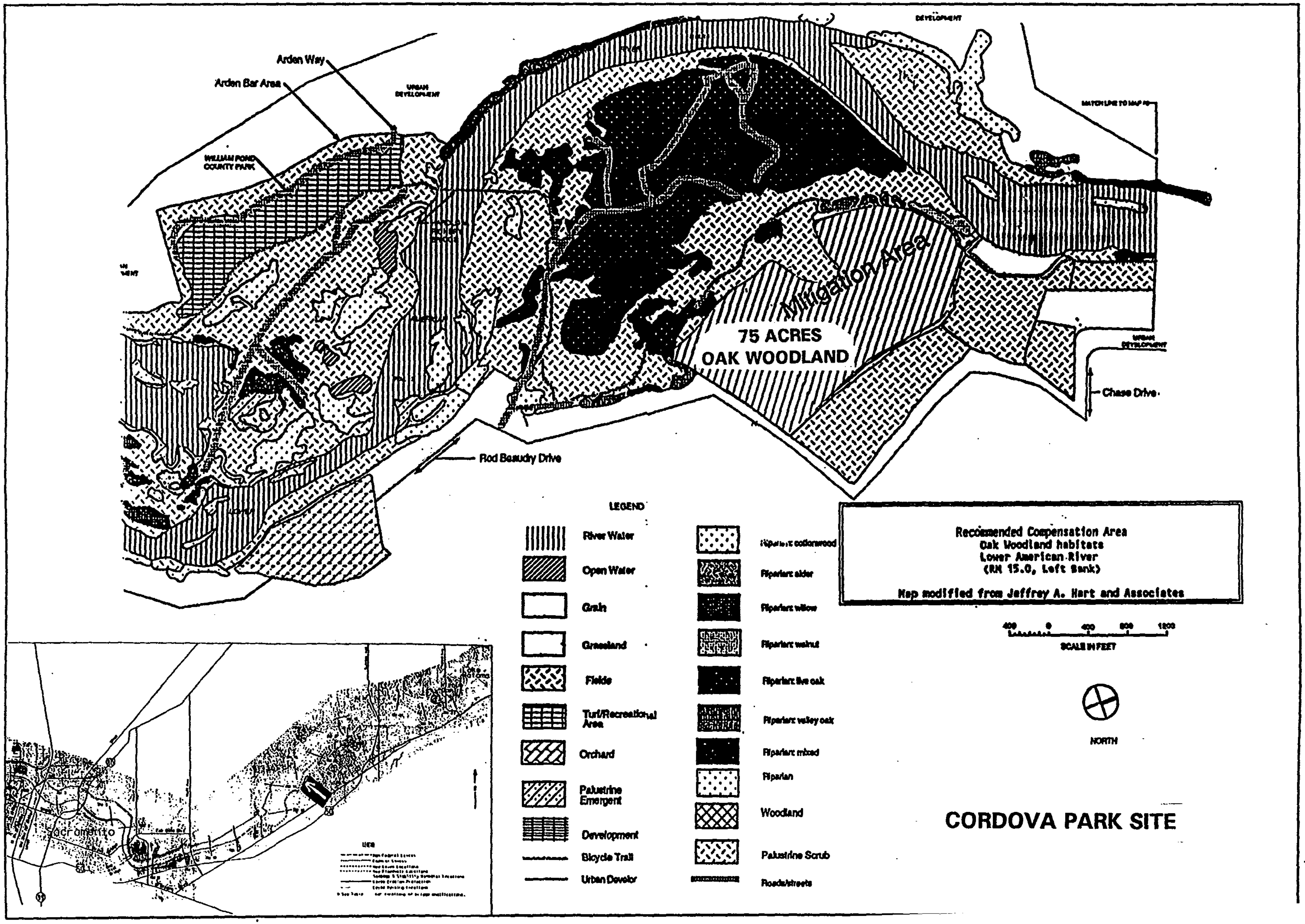

Arden Way
Arden Bar Area
WILLIAM POND COUNTY PARK
URBAN DEVELOPMENT
DEVELOPMENT
MATCH LINE TO MAP
Chase Drive
Rod Beaudry Drive
75 ACRES
OAK WOODLAND
Mitigation Area
LEGEND
River Water
Open Water
Grain
Grassland
Fields
Turf/Recreational Area
Orchard
Palustrine Emergent
Development
Bicycle Trail
Urban Develor
Riparian cottonwood
Riparian alder
Riparian willow
Riparian walnut
Riparian live oak
Riparian valley oak
Riparian mixed
Riparian
Woodland
Palustrine Scrub
Roads/streets
Recommended Compensation Area
Oak Woodland habitats
Lower American River
(RM 15.0, Left Bank)
Map modified from Jeffrey A. Hart and Associates
400 0 400 800 1200
SCALE IN FEET
NORTH
CORDOVA PARK SITE
Sacramento

Figure 8-4

Downstream from American River. Mitigation for work in the Sacramento Bypass and the Yolo Bypass would be done at one site. This site would allow for compensation of impacts to riparian and wetland habitats from work along the delta sloughs and Sacramento Bypass; the site is on a 116-acre portion of Liberty Island. The selection of this site, which is just north of and adjacent to the existing Cache Slough mitigation site, would allow creation of a larger combined habitat site of greater value to the evaluation species than smaller, fragmented mitigation sites. Land use is currently agricultural (figure 8-5).

The predominant cover types affected include grassland, agriculture, emergent marsh, riparian shrub, and oak woodland. The loss of grassland and agriculture habitat would not be significant to wildlife because both habitats provide little value. Should emergent marsh and riparian habitat be lost, the wildlife species that rely on these habitats could be displaced if their foraging and nesting areas are reduced.

VEGETATION RESTORATION PROPOSAL

The restoration component of the stepped release plan consists of developing sloughs between river miles 2.5 and 3.7 in the Woodlake area of the lower American River Parkway. The interconnecting sloughs and associated ponds would promote riparian habitat growth by circulating water over a wide area.

Water sources include the Natomas East Main Drainage Canal; several stormwater drains and pumps would direct excess winter runoff into an existing ditch system and into the new sloughs. Additional water may be supplied by American River overbank flooding during releases exceeding 20,000 cfs. The slough would be about 10 feet wide, 10 feet deep, and have gently sloping sides to encourage riparian growth. Constructing the slough would require excavating about 400,000 cubic yards of material. This excavated material may be suitable for filling in portions of the 57-acre Urrutia gravel mining site that has since filled with water. The mining pit is currently devoid of vegetation due to its steep side slopes. Some or all of the 400,000 cubic yards of excavated material from the slough creation could be used to partially fill the pit, paying particular attention to lessening the side slopes to allow vegetation to become established around the pit's perimeter. In addition, islands would be created to add additional areas for vegetation establishment.

These two restoration plan components would help reestablish riparian and wetland habitat in areas of the parkway that currently are used for agriculture or mining. The restoration component would complement the 38-acre mitigation area at the tip of the Woodlake site that would be used to mitigate the construction impacts of the Stepped Release Plan on riparian habitat. This mitigation site borders the proposed restoration area. The total area affected by the restoration, including areas surrounded by the newly created slough and the restoration of the Urrutia mining pit, would be about 144-acres.

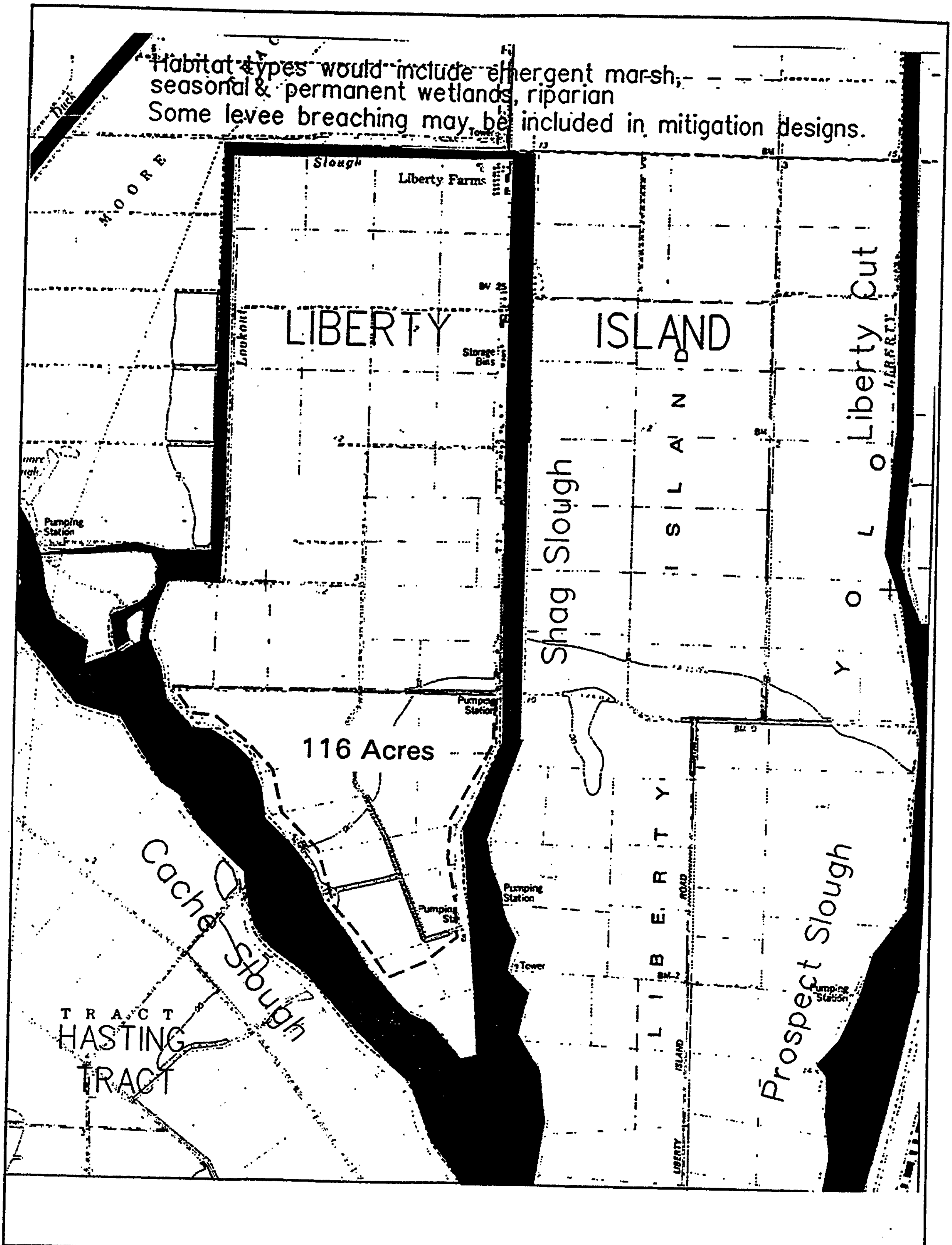


Figure 3. Environmental Mitigation: Downstream from American River - Liberty Island

ENDANGERED SPECIES

No-Action Condition

Construction of the features included in the Stepped Release Plan would potentially affect the following Federal or State-listed threatened, endangered, or candidate species: valley elderberry longhorn beetle (FT), Swainson's hawk (ST), giant garter snake (ST, FT), Delta smelt (FT, ST), winter-run chinook salmon (FE, SE), and the Sacramento splittail (FC). The conditions in the project area which support these species have been previously described (see Endangered Species discussion in chapter 4 and under the No-Action Alternative in chapter 6).

Significance Criteria

For purposes of this evaluation, any action taken directly in connection with, or indirectly caused by, the project which would affect the continued existence of a threatened or endangered species is considered a significant adverse impact.

Impacts

The Stepped Release Plan would increase the potential for stranding steelhead trout redds and juveniles and winter-run chinook salmon juveniles if flows are reduced at higher rates than would occur under the No-Action alternative.

The increased potential for stranding of winter-run chinook salmon and steelhead trout juveniles should be reduced by minimizing the rate at which flows are reduced during the winter and spring reservoir storage period. Actual impacts will depend to a large extent on daily operation of the reservoir in response to daily precipitation and runoff conditions, and downstream water needs for salinity control, fish and wildlife resources, and exports.

Active Swainson's hawk nests could be destroyed or disturbed during construction activities along the lower American River, the Sacramento River, and the Yolo Bypass under the Stepped Release plan. Loss of nests or disturbance to nests resulting in loss of eggs or death of young would adversely affect the Swainson's hawk.

Implementation of the Stepped Release Plan could affect 137 elderberry shrubs from construction activities along the lower American River and Yolo Bypass. This loss of elderberry shrubs would have an adverse effect on VELB.

Construction activity along levees in the Natomas area and the Yolo Bypass under the Stepped Release Plan could kill hibernating giant garter snakes.

Mitigation

Lower American River and Downstream from American River. FWS compensation guidelines for the beetle would be implemented to mitigate for the 137 elderberry shrubs potentially lost to construction. Replanting would take place within the lower American River Parkway near the affected shrubs. Replanting would take place within the lower American River Parkway near the affected shrubs.

To avoid affecting the giant garter snake, seasonal restrictions on construction activities (October 1 through May 1) to potential giant garter snake habitat would be implemented according to DFG guidelines (DFG, 1992). Construction within giant garter snake habitat would be restricted to nonhibernating periods.

While potential water temperature impacts on listed fish species are considered minimal, reconfiguration and operation of the shutters as proposed by SAFCA should be implemented to improve water temperatures in the lower American River for anadromous salmonids.

To avoid impacts on the Swainson's hawk, seasonal restrictions would be implemented on construction activity according to DFG guidelines for mitigating impacts on the Swainson's hawk (DFG, 1994).

To avoid affecting the bank swallow, surveys would be conducted along the lower American River to determine if any bank swallow colonies are active during any construction year. If a bank swallow colony is active within 0.25 mile of proposed construction activity, to avoid impacting the colony, USCOE will implement seasonal restrictions on construction activity in coordination with DFG.

To mitigate for this loss, FWS compensation guidelines for VELB would be implemented.

USCOE will implement seasonal restrictions on construction activities (October 1 through May 1) in potential giant garter snake habitat according to DFG guidelines (DFG, 1992).

WATER QUALITY

No-Action Condition

Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. These low flows periodically result in high water temperatures that may jeopardize juvenile fish. Runoff from the portions of the lower American River area north of the river is collected and discharged

into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

Significance Criteria

For purposes of this analysis, any degradation in water quality below standards established by the Regional Water Quality Control Board or EPA would constitute a significant impact.

Impacts

Lower American River. This alternative includes 29 miles of levee modifications that include slurry walls, levee raising, construction of new levee lengths, floodwalls, and revetment to prevent surface erosion. These construction activities could cause or allow sediment to enter the river. Assuming proper construction procedures are followed (for example, construction during low-flow periods, use of clean material, construction of sediment barriers, and revegetation of disturbed areas), the effects on water quality would be minimized. There would be no long-term degradation of water-quality parameters in the lower American River area.

Downstream from American River. This alternative includes widening Sacramento Bypass by 1,000 feet, modifying the levees through the Yolo Bypass by constructing or modifying landside stability berms, raising or reconstructing existing levees, and placing revetment at various locations along both the landside and waterside of the levees. Assuming proper construction procedures are followed (for example, construction during low-flow periods, use of clean material, construction of sediment barriers, and revegetation of disturbed areas), the effects on water quality would be minimized. There would be no long-term degradation of water-quality parameters in the lower Sacramento River or bypass areas.

Mitigation

No mitigation would be necessary because typical construction activities require the use of containment barriers, fences, or dikes to reduce erosion. All work would be accomplished during low-flow periods, and generally well away from flowing water. No mitigation is required because there would be no significant degradation of water-quality parameters in the area.

CULTURAL RESOURCES

No-Action Condition

Within the lower American River study area, three prehistoric sites are listed on the National Register (CA-SAC-26, -39, -99); one historic site, the Natomas East Main Drainage Canal levee, has recently been determined eligible for the Register as a contributing element to the Rural Historic Landscape District of Reclamation District 1000 (Dames &

Moore, 1995). Archeological investigations at two additional sites, CA-SAC-155 (Neuenschwander and Peak, 1988) and CA-SAC-319 (Peak & Associates, 1983), have resulted in recommendations of National Register eligibility, while similar studies at CA-SAC-199 (Dougherty, 1984) show that this property is ineligible to the NRHP. None of the remaining 35 sites in the lower American River area have been evaluated for the NRHP.

Four bridges within the project area were evaluated in the Thematic Request for Determination of Eligibility for Historic Highway Bridges in California 1985-1986 (Caltrans, 1986). The Jibboom Street bridge and Old Fair Oaks bridge were determined eligible for the NRHP in December 1985 under Criterion A as locally important crossings and under Criterion C as distinctive examples of a type and method of construction. Nothing has occurred since that determination that would change the eligibility of these two properties. The American River bridge was determined to have lost integrity and as a result is not eligible for the NRHP. Nothing has occurred that would change the earlier finding of ineligibility. The H Street bridge was determined not eligible for the NRHP; however, Caltrans plans to reevaluate this bridge. It may be eligible under Criterion C as a significant example of engineering.

Three railroad bridges were surveyed. The Northern Electric bridge may be eligible for the NRHP under Criterion A as an important element of a major northern California interurban railroad; it may also be eligible for the NRHP under Criterion C as a distinctive example of a type of construction. The Western Pacific bridge may be eligible for the NRHP under Criterion A as an important element on the main line of a railroad important in the development of California; it may also be eligible for the NRHP under Criterion C as a distinctive example of a type of construction. The Southern Pacific bridge may qualify for the NRHP under Criterion A as an example of E.H. Harriman's extensive upgrading program for the Southern Pacific Railroad; it may also be eligible under Criterion C as an example of engineering. More research is required for all three railroad bridges to make a definite evaluation.

Reclamation District 1000 (RD 1000) Rural Historic Landscape District was determined eligible for the NRHP in September 1994. A portion of the East Levee and the Natomas East Main Drainage Canal are within the project area. Also, a portion of the historic road alignment for the Garden Highway is on the top of the East Levee west of Northgate Boulevard. Levee Road is on the top of the East Levee east of Northgate Boulevard. East Levee, NEMDC, Garden Highway, and Levee Road are contributors to the RD 1000 Rural Historic Landscape District.

The portion of the south bank levee of the American River beginning at the confluence of the Sacramento River and ending on the west side of the Mayhew Drain and the portion of the northbank levee beginning on the eastern side of the NEMDC and continuing to the California State Exposition may be eligible for the NRHP under Criterion A as a part of the Sacramento River Flood Control Project. Both levees were part of the plan approved by the State Legislature in 1925 and authorized for construction by Congress

prior to December 1944. The levee system of the American River is already recognized as a local Historic Civil Engineering Landmark.

The tailings district just south of the Nimbus Dam on the south bank in the American River Parkway is part of the Folsom (American River) Mining District, which is currently undergoing National Register evaluation (M. Maniery, pers. comm., 1995).

Downstream from American River. Within the lower Sacramento River study area, the Sacramento Weir is eligible for the NRHP. Two prehistoric sites are known to exist within the Yolo Bypass (Bouey, 1991), but neither has been formally evaluated for the NRHP. In addition, it appears that the levees of the Sacramento Bypass and portions of the levees of the Yolo Bypass are eligible for the NRHP under Criterion A as part of the Sacramento River Flood Control Project. The Sacramento Weir and both bypasses were part of the plan approved by the State Legislature in 1925 and authorized for construction by Congress prior to December 1944.

There are no State Historic Landmarks within the lower American River or lower Sacramento River study areas. One prehistoric site within the lower American River segment, CA-SAC-99, is listed as a California Point of Historical Interest (SAC-003). Three such projects are within the lower American River or lower Sacramento River study: the I Street and Tower bridges in Sacramento, the Sacramento Weir, and the entire system of levees, weirs, and floodways along the Sacramento and American Rivers (American Society of Civil Engineers, 1976; Corps,1992).

Significance Criteria

For purposes of this analysis, impacts to cultural resources are considered significant if the property is a site, building, structure, or object which is recognized as culturally or historically significant based on the institutional, public, or technical criteria described under the Cultural Resources for the No-Action Alternative.

Impacts

Lower American River. The cultural resources inventory of the lower American River area of potential effect focused only on direct impact areas relating to levee improvements or levee and floodwall construction along a 23-mile-long corridor of the American River extending from Nimbus Dam to its confluence with the Sacramento River. No systematic inventory was undertaken outside the direct impact areas. Thus, the number and types of archeological sites in the area between the river corridor and the proposed and existing levees remains unknown. The possibility of additional impacts to potentially eligible National Register properties associated with an increase in the current objective release out of Folsom Dam has yet to be examined. This would require an intensive pedestrian survey along the river bars and terraces between the river corridor and the existing or proposed levee locations to ensure compliance with Section 106 of the NHPA.

Within the direct impact area of potential effect, five archeological sites, CA-SAC-157, -158, -320, and LAR-10 and -15, will be affected as a result of activities related to new levee construction. These impacts would be significant if the affected properties met any of the institutional, public, or technical criteria outlined above.

Downstream from American River. Proposed levee strengthening and raising along the landside berm of the Garden Highway (River Levee) bordering the Sacramento River between river miles 66.8 and 78.9 have the potential to affect a number of prehistoric and historic sites. Further analysis of project impacts is required before a more accurate assessment can be made.

This plan also involves levee strengthening and raising portions of the historic south bank and north bank levees of the American River. These changes may lessen integrity of the Sacramento River Flood Control Project.

This plan would involve lengthening the historic Sacramento Weir by 1,000 feet, including the River Road and Northern Railroad. Also, the historic Sacramento Bypass would be widened 1,000 feet and levees of the bypass raised. This change to the historic design, materials, and location of the Sacramento Weir and Bypass will result in a loss of integrity. This would be a significant adverse impact.

The plan would also involve raising 26 miles of levees in the Yolo Bypass, building 2 miles of new levees, and strengthening 38 miles of levees. These changes may result in the loss of integrity to the Yolo Bypass levees as part of the Sacramento River Flood Control Project.

The survey of the historic landscape characteristics of the Yolo Bypass was not a part of the historic structures survey. However, it is possible that portions of the land within the bypass may be eligible as a rural historic landscape district(s). This indirect growth-inducing impact could have an adverse impact on any potentially eligible rural historic properties related to reclamation or agriculture.

Mitigation

A cultural resources Programmatic Agreement (PA) has been developed and adopted between the Corps, the Office of Historic Preservation, and the Advisory Council on Historic Preservation regarding implementation of the ARWP. Other signatories of the PA include the Bureau or Reclamation, Mid-Pacific Region; Reclamation Board of the State of California; and Sacramento Area Flood Control Agency. This PA will be used to complete Section 106 responsibilities for the wide range of related Federal actions expected to be carried out in connection with the ARWP. The PA includes procedures for treatment of indirect and direct impacts of the levee improvements associated with the projects. The executed PA specifies inventory (Stipulation 2) and National Register evaluation procedures (Stipulation 3) for historic properties, as well as the process for development of Historic Properties Treatment Plans (Stipulation 4). Additionally, report format and review

(Stipulation 5), participation of interested persons (Stipulation 6), curation of recovered data (Stipulation 7), and professional qualifications (Stipulation 8) are also detailed.

As specified in the Corps 1991 EIS/EIR for the ARWP, mitigation measures may include archeological documentation, architectural and engineering documentation, and historical documentation, following standards and guidelines promulgated by the Secretary of the Interior (FR 48:190).

AGRICULTURAL/PRIME AND UNIQUE FARMLANDS

No-Action Condition

There are currently prime, unique, and statewide important farmlands in Yolo and Solano Counties that would not be affected under the No-Action Alternative but that could be affected under the Stepped Release Plan.

Significance Criteria

For purposes of this analysis, any substantial long-term disruption of an existing or reasonably foreseeable agricultural land use is considered to be a significant impact.

Impacts

Lower American River and Folsom Reservoir. Because there are no agricultural or prime and unique farmlands in the lower American River or Folsom Reservoir areas, there could not be any adverse effect to these areas. Agricultural lands in the upper American River area would not be affected by this alternative.

Downstream from American River. Levee modifications associated with the Stepped Release Plan would permanently disrupt use of farmland adjacent to the north levee of the Sacramento Bypass. This levee would be moved 1,000 feet north of its current alignment, isolating approximately 230 acres of land currently in agricultural production. Levees along the Yolo and Willow Slough Bypasses and along Cache and Haas Sloughs would be raised. Stretches of the levees along these channels and the levees along Lindsey Slough would be strengthened. This levee work would permanently affect about 628 acres of farmland or vacant land. Of this total, USDA classifies approximately 400 acres as prime and unique farmlands; approximately 50 acres are considered to be of statewide importance. Construction may temporarily disrupt agricultural use of the adjacent lands. These temporary impacts are adverse; however, they are not considered to be significant under the criteria of the Farmland Protection Policy Act of 1981 as amended in 1994.

The borrow sites for the Yolo Bypass levee work are: (1) the Cache Creek settling basin and a West Sacramento site. The borrow sites for levee work along the sloughs in the Delta include one north of Rio Vista along the west bank of the Sacramento River and

another, Decker Island, south of Rio Vista near the east bank of the Sacramento River. Excavation of material for levee work at these existing borrow sites would not affect agricultural lands.

Mitigation

No mitigation would be required for converted farmlands.

HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE

No-Action Condition

Over 1,000 hazardous waste sites have been located within the flood plain portion of the project area. Of these sites, 334 could result in significant contamination if they were inundated. These sites are host to leaking tanks, pits containing hazardous substances, and similar storage or disposal facilities. Of these potentially dangerous sites, 175 present an especially serious threat. This category includes sites slated for cleanup or further monitoring under one or more of the governmental efforts to address hazardous and toxic waste issues in the Sacramento area. Aside from these listed sites, the flood plain contains other hazardous materials which could cause significant problems in the event of a flood. These include aboveground tanks and drums, which may contain heating or fuel oil, liquid propane, kerosene, and agricultural chemicals.

Significance Criteria

The significance criteria for HTRW is based on both institutional and public recognition of potential public health risks if contaminants are introduced into the environment. For the purposes of this analysis, any action which substantially increases the risk of an uncontrolled release of hazardous or toxic materials into the environment is considered significant.

Impacts

Lower American River. No construction impacts are expected with this plan.

Folsom Reservoir. No construction impacts are expected with this plan.

Downstream from American River. The East Yolo County landfill occupies a parcel about 400 feet wide by 2,200 feet long and averages about 5 feet deep. The landfill is adjacent to the existing north levee of the Sacramento Bypass. Records show that the landfill began operation in 1940 as a private business known as the "Albericci Dump." It was used to dispose of residential and commercial solid wastes by sequentially burning, crushing, and burying them. This "burn dump" methodology also usually incorporated salvaging of metals and chemicals whenever possible. Relocation of the north levee of the Sacramento Bypass

would result in soil disturbance at the "Albericci Dump" site or cause inundation of the dump.

Mitigation

Downstream from American River. The State's investigation also recommended that if a future levee relocation results in excavation of the landfill area, the most desirable remedial action would be to relocate the landfill material to a different authorized site. According to the Yolo County Department of Public Works, the current Yolo County landfill north of Davis is the most likely site for relocation of the dump. The old dump contains a relatively small volume of nonhazardous landfill material which should not be a major logistical problem to relocate.

TRANSPORTATION

No-Action Condition

Folsom Dam Road, a two-lane roadway, crosses the top of the dam and runs beneath the mobile crane. Reclamation allows public use of the roadway between 6 a.m. and midnight. The roadway lanes are substandard in width and have no shoulders; however, the road is one of the few crossings of the American River in the area and represents an important arterial connecting the City of Folsom and western El Dorado County to communities in northeastern Sacramento County and southern Placer County.

Significance Criteria

Three criteria were use to determine if project-generated traffic and transportation impacts would be significant. First, where project-added traffic volumes would contribute to or degrade any existing peak-hour intersection level of service (LOS) to LOS "D" or below, the project was considered to have a significant impact. Second, in instances where project traffic would create a substantial safety risk, this impact was considered significant. Third, where project vehicle weight would exceed roadbed design standards, potential impacts to road surfaces were considered significant.

Impacts

Based on the above significance criteria, the likely impacts of construction-related traffic associated with the Stepped Release Plan were evaluated. Particular attention was given to vehicle trips between identified borrow sites and their associated construction destinations.

Guy West. Foot and bicycle traffic currently using the Guy West bridge would be routed over the H Street bridge, approximately 1/2 mile from the site. This would be

accomplished by installing pedestrian detours along the levees and through the walkway on the upstream side of the H Street bridge. The construction period is estimated to be 1-year.

Howe Avenue. Work at this bridge would require that one of two structures be raised at a time. Traffic would be routed across the structure which was not being raised, reducing traffic to one lane in each direction.

Impacts to transportation along Garden Highway would be treated in the same manner as under the Folsom Modification Plan.

Total Transportation Impacts. Construction of all elements of the Stepped Release Plan would take 9 years to complete; work would be done simultaneously in all areas throughout the year. For the lower American River, 37 trucks per day would be needed to construct the levee modifications, including new levees, levee raising, and adding revetment to some levee slopes. For the area downstream of the American river, 100 trucks per day during the construction season would be needed for the same types of levee work.

Mitigation

To reduce the direct construction impacts associated with the various project alternatives in all project areas, the following measures shall be implemented:

- The contractors shall prepare a transportation plan with information on haul routes and the number of trucks per day, as well as a traffic engineering analysis indicating that potential affected intersections have adequate turning radii for oversized vehicles.

- Contractors shall avoid hauling on public roads during weekday peak traffic periods, such as 6:30-9:30 a.m. and 3:30-6:30 p.m., especially in developed areas. If this is not feasible, contractors shall prepare traffic engineering studies to include peak-hour capacity calculations at affected intersections along haul routes, demonstrating that acceptable levels of service will be maintained. These studies shall be prepared for the Corps and shall conform to appropriate local standards. Contractors shall also allow pertinent agencies and concerned neighborhoods to comment on the transportation plan and traffic engineering studies. Where construction access is by local roads, residents shall receive prior notification.

- Reroute Garden Highway traffic around construction areas.

AIR QUALITY

No-Action Condition

Most of the lower American River is in the Sacramento Valley Air Basin. The principal air pollutants in this area are ozone, nitrous oxides, and carbon monoxide. While

ozone tends to be a regional problem dispersed over wide areas, CO problems are usually localized and result from a combination of high traffic volumes and traffic congestion. The two primary sources of air pollution in the American River area are motor vehicles and stationary industrial facilities and operations.

The Folsom Reservoir area is heavily influenced by air contaminants originating in the Sacramento region and from agricultural burning in the Sacramento Valley. Interstate 80, Highway 50, and local industries are also sources of air pollution. Air contaminants are concentrated most often when the atmosphere is stable and winds are light for long periods of time.

The Sacramento Air Quality Management Area is not expected to reach attainment for ozone or CO before the year 2000. Traffic-related hydrocarbons, nitrogen oxides, and carbon monoxide will increase, worsening the basin's non-attainment status. The primary causes will be increased auto traffic associated with increased development and land use changes in the area. Most hydrocarbon and nitrogen oxide emissions will come from vehicle trips that originate outside the City of Sacramento, primarily from people commuting, shopping, and also from through traffic.

Significance Criteria

According to appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it violates any ambient air-quality standard, contribute substantially to an existing or projected air-quality violation, or expose sensitive receptors to substantial pollutant concentrations.

Significance criteria developed by the SMAQMD and by the EPA were used in determining the significance of project-related air quality impacts. Project-related emissions were considered significant if emissions exceeded the SMAQMD's thresholds of:

- 85 pounds per day (ppd) of ROG,
- 85 ppd of NO_x, or
- 275 ppd of PM10 (Sacramento Metropolitan Air Quality Management District 1994).

Also, project-related annual emissions were considered significant if emissions exceeded EPA's general conformity thresholds. Those conformity thresholds are based on the de minimis thresholds included in EPA's general conformity guidance regulation for the Sacramento area (40 CFR Part 51 Subpart W and 40 CFR Part 93 Subpart B). The threshold levels equal:

- 25 tons per year for ROG
- 25 tons per year of NO_x,
- 100 tons per year for CO, or
- 100 tons per year for PM10.

Impacts

Upper American River. The Folsom Stepped Release Plan Alternative would generate no emissions in the upper American River.

Folsom Reservoir. The Folsom Stepped Release Plan Alternative would generate emissions in the Folsom dam area from modifications to the spillway and outlet works.

Lower American River . The Folsom Stepped Release Plan Alternative would generate emissions in the lower American River area as a result of levee raising and strengthening.

Lower Sacramento River. The Folsom Stepped Release Plan Alternative would generate emissions in the lower Sacramento River area as a result of levee raising and strengthening.

Table 8-4 shows that emissions of ROG, NOx, and CO would exceed the daily or annual emission thresholds established for the Sacramento area. This is considered a significant impact.

As shown in table 8-4 emissions associated with the Stepped Release Plan exceed the tons-per-year conformity thresholds established by the EPA. Consequently, a conformity analysis must be conducted to show that this alternative would not violate the Sacramento area's State Implementation Plan.

Mitigation

The Corps will prepare a dust suppression plan and submit it to the SMAQMD and the Yolo-Solano Air Pollution Control District for review before initiating construction activities. The plan will include as many of the following mitigation measures as are applicable to each project site:

- Cover, enclose or water active storage piles at least twice daily.
- Cover inactive storage piles.
- Pave all haul roads.
- Cover securely or maintain at least 2 feet of freeboard on all haul trucks when transporting material.
- Water all active construction sites at least twice daily. Frequency should be based on the type of operation, soil, and wind exposure.
- Maintain the natural topography to the extent possible to eliminate the need for

extensive land clearing, blasting, ground excavation, grading, and cut-and-fill operations.

- Prohibit all grading activities during periods of high wind (i.e., greater than 30 miles per hour).

- Apply chemical soil stabilizers on inactive construction areas (disturbed lands within construction projects that are unused for at least 4 consecutive days).

- Apply nontoxic binders (e.g., latex acrylic copolymer) to exposed areas after cut and fill operations and hydroseed area.

- Plant tree windbreaks on the windward perimeter of construction projects if they are adjacent to open land.

- Plant vegetative groundcover in disturbed areas as soon as possible.

- Install wheel washers for all exiting trucks.

- Sweep streets if visible soil material is carried onto adjacent public roads.

- Post a publicly visible sign at the project site to specify the telephone number and person to contact regarding complaints. This person shall be responsible for responding to complaints and taking corrective action within 48 hours.

- Incorporate NOx Mitigation Measures into Construction Plans.

- Require injection timing retard of 2 degrees on all diesel vehicles, where applicable

- Install high-pressure injectors on all vehicles, where feasible.

- Encourage the use of reformulated diesel fuel.

- Use pre-chamber diesel engines (or equivalent) together with proper maintenance and operation.

- Electrify equipment, where feasible.

- Maintain equipment in tune with manufacturer's specifications, except as otherwise stated above.

- Install catalytic convertors on gasoline-powered equipment.

- Substitute gasoline-powered for diesel-powered equipment, where feasible.

TABLE 8-4

Construction Equipment Emissions - Stepped Release Plan

Year	Carbon Monoxide (CO)		Reactive Organic Compounds (ROG)		Nitrogen Oxides (NO_x)		Sulfur Oxides (SO_x)		Inhalable Particulate Matter (PM10)	
	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day
2000	152	1,254	19	151	364	2998	40	324	65	718
2001	161	1,468	20	185	387	3548	42	384	66	759
2002	205	1,623	25	201	486	3,878	53	417	73	774
2003	331	2,513	39	297	771	5,890	83	634	90	898
2004	289	2,131	35	270	673	4,954	73	535	84	840
2005	288	2,238	34	267	669	5,246	72	564	83	857
2006	211	1,533	24	175	480	3,515	52	376	30	217
2007	379	2,682	46	327	896	6,379	97	687	166	1799
2008	290	1,966	36	246	700	4,748	76	512	155	1697
2009	103	723	14	105	263	1,868	29	209	128	1524
2010	0	0	0	0	0	0	0	0	0	0
Maximum	379	2,682	46	327	896	6,379	97	687	166	1799

- Use compressed natural gas or onsite propane mobile equipment instead of diesel-powered equipment, where feasible.

Conformity. The Folsom Stepped Release Plan is potentially subject to the general conformity rule but would not be subject to transportation conformity requirements.

As shown in Table 8-4 emissions associated with the Folsom Stepped Release Plan exceed the tons per year conformity thresholds established by EPA. Consequently, a conformity analysis must be conducted to show that this alternative would not violate the Sacramento area's SIP.

The conformity analysis should not be conducted until the Corps has decided which alternative it wants to implement since all three action alternatives are currently subject to conformity. The conformity analysis requires air-quality modeling and/or the purchase of emission reduction credits to offset the increase in emissions associated with project construction. Consequently, the detailed general conformity analysis should be conducted only after a plan has been selected for implementation.

NOISE

No-Action Condition

Adjacent uses in the construction area include recreation on the waterside and commercial, industrial, and residential on the landside. The ambient background levels range from 51.1 to 61.6 dBA. Structures are located within 20 to 100 feet of the slurry wall construction sites.

Significance Criteria

The significance criteria used to evaluate anticipated noise conditions are based upon project-related incremental noise increases at the construction sites. Noise from construction activities will be compared to the city's criteria for nontransportation-related noise sources. An increase in noise of 3 dB or less is typically not perceptible, while a 5 dB increase is usually perceived as being distinctly perceptible. Consideration is given to the magnitude of the charge in assessing significance.

The noise standard that would apply to each project improvement site is contained in the General Plan Noise Element for that respective jurisdiction. All respective noise elements cite 60 dBA L_{dn} as the established daytime residential noise standard. The impacts of project-generated noise were assessed through site inspections, accepted noise modeling techniques, and existing noise data. Site inspections identified existing noise sources and located noise-sensitive land uses in the vicinity. Noise-sensitive land uses were typically considered to be residential, educational, church, library, and health-related facilities, and significant noise sources included surface traffic, railroads, industries, and aircraft.

Noise impacts were assessed at each of the sites by comparing project-generated construction and operational noise levels, existing noise levels, and the criteria and standards contained in applicable planning documents. In this case, the criteria applicable are primarily for noise-sensitive residential uses and are intended to provide a suitable environment for indoor communication and sleep.

Impacts

Lower American River. Insertion of a slurry wall into the levees along both sides of the American River would generate construction noise near residential areas. These impacts would be considered short-term adverse in most areas since construction would be temporary and would take place during the day. Nevertheless, heavy-duty construction equipment would be expected to produce noise levels which exceed adopted standards in some areas where noise-sensitive receptors are adjacent to the construction site. In these cases, impacts would be considered short term but significant.

Folsom Reservoir. This alternative would also require alteration of the Folsom Dam spillway and outlet works to allow for an increase in design release events. To complete construction of a gate during one construction season, it would be necessary to work 20 hours each day. This would require the use of materials handling and stationary source construction equipment similar to that listed in figure 7-1. These pieces of equipment can produce noise in the 70 to 88 dBA range as measured 50 feet from the noise source. In addition to these pieces of equipment, jackhammers would probably be used to break up concrete below the spillway. Jackhammers can produce noise levels of up to 90 dBA at 50 feet. Delivery truck traffic and other mobile sources would also add to construction noise at the improvement site. All sources of project construction noise would contribute a short-term noise impact to nearby sensitive receptors. This impact would be considered significant and unavoidable. The above information is based on the results of the Montgomery-Watson study for the Corps entitled "American River Flood Control Project Task 2: Lowering Folsom Spillway" (March, 1994).

Downstream from American River. Noise impacts would be associated with raising and strengthening the levees along the Sacramento River. Heavy-equipment noise would be the major concern during levee-related and dam construction activities. Primary sources of noise in these cases would be engine exhaust, fans, transmissions, and other mechanical equipment.

Mitigation

The following discussion is for the construction activities along the lower American River and downstream from the American River. Mitigation for work at Folsom Dam is the same as that presented for the Folsom Modification Plan.

Heavy-equipment noise would be the major concern during levee-related and dam construction activities. Primary sources of noise in these cases are engine exhaust, fans,

transmissions, and other mechanical equipment. Heavy equipment is typically fitted with mufflers and engine enclosures to allow operation in noise-sensitive areas. Thus, the source of noise may be controlled within technological limits by requiring adequate mufflers and enclosures to be maintained on heavy equipment and other noise-producing tools.

When reasonably controlled, construction noise is often accepted by the public during daytime (7 a.m. to 5 p.m.). People are less tolerant of noise and may complain if nonemergency construction activities continue at night. Preventing nighttime construction near noise-sensitive receptors can effectively reduce public concerns.

The following measures, therefore, are recommended to reduce the project's short-term construction-related noise impacts on adjacent noise-sensitive land uses.

- Mufflers shall be provided for all project-related heavy construction equipment and stationary noise sources (such as diesel generators). Stationary noise sources shall be located at least 300 feet from occupied residences or contractors shall be required to provide appropriate noise-reducing engine-housing enclosures.

- Equipment warmup areas, water tanks, and equipment storage areas shall be placed in a central area as far away from existing residences as is feasible.

Implementation of the above onsite construction noise mitigation measures would reduce the project's short-term noise impacts to the greatest extent feasible. However, due to the proximity of existing noise-sensitive receivers (residences), the project's short-term construction noise impacts would remain significant and unavoidable at Folsom Dam and the lower American River improvement sites.

Construction-related traffic noise can be reduced at noise-sensitive receiver locations by ensuring that all traffic complies with applicable noise emission standards. Often traffic can be routed to minimize exposing these areas to heavy truck traffic.

To reduce the project's mobile source construction noise impacts, the following measures are recommended.

- All onroad mobile construction vehicles (dump trucks) shall be equipped with mufflers.

- All dump truck haul trips shall follow only the haul routes analyzed in this report unless a waiver is received from the appropriate agency.

- No dump truck haul trips shall be allowed in residential areas prior to 8 a.m. or after 6 p.m.

The above mobile source noise mitigation measures would reduce project-generated mobile source noise to the greatest extent feasible. Where haul trips occur in residential

neighborhoods in the lower American River area under the project alternatives, residual mobile source noise impacts would also be considered adverse but less than significant.

VISUAL RESOURCES

No-Action Condition

Under the No-Action Condition, visual resources at Folsom Reservoir and the State Recreation Area would remain subject to the same natural and operational regimes to which they are now subject; the reservoir is considered to have been impaired for some time. Visual resource values along the lower American River are considered to be high. The area downstream from the American River (Yolo and Sacramento Bypasses) is almost entirely developed with agriculture, and there is little visual diversity. Construction of the features included in the Stepped Release Plan would potentially affect the quality of visual resources along the lower American River and in the Folsom Reservoir area.

Significance Criteria

For a project component to have a significant impact, the project or features of a project must substantially alter the visual quality of sensitive viewing components within the observable scene. Such an alteration may include a project feature significantly blocking a desirable viewing component, or replacing valuable environmental resources previously regarded as a visual amenity.

Impacts

Lower American River. Increasing the releases from Folsom Dam would necessitate building new levees and floodwalls, and raising or otherwise modifying 25 miles of levees along the lower American River. These improvements would affect 425 acres of wildlife habitat, including 24 acres of riparian and scrub-shrub vegetation, 14 acres of oak woodland, and 387 acres of upland herbaceous habitat. The affected levees are almost entirely in residential neighborhoods. Because mitigation for lost vegetation would be accomplished offsite, residents would be left with an altered viewscape, particularly in neighborhoods adjacent to the new levee and floodwall sections. This is considered a potentially significant impact. Placement of hydroseed for erosion protection would be done on the waterside of the levee, somewhat reducing the visual alteration. Levee work along the lower American River is considered to be a significant and unavoidable impact which cannot be mitigated onsite due to necessary operation and maintenance of the levees.

Raising the Howe Avenue and Guy West bridges to accommodate higher flows in the river would not result in adverse visual effects because the current alignments of these bridges would be unaffected and the raises relatively minor.

Modification of existing pumping facilities would not adversely affect the existing look of these facilities; however, construction of large new pumping facilities at the mouth of the Mayhew Drain and at the Boyd Station channel would alter existing viewscapes. This is considered a potentially significant impact.

Folsom Reservoir. Enlargement of Folsom Dam's river outlets and modifications of the dam spillway as called for under the Stepped Release Plan would not significantly alter existing viewscapes of the dam and reservoir.

Downstream from American River. Required improvements to levees in the Yolo Bypass would affect 403 acres of habitat, including 283 acres of upland herbaceous, 43 acres of emergent marsh, 64 acres of riparian habitats, 8.3 acres of seasonal wetland habitat, and 5 acres of oak woodland. The loss of this habitat would be mitigated on Liberty Island except for the oak, which would be mitigated at a site along the lower American River. The proposed improvements would affect viewscapes only for the few residences in the areas. These impacts would not be considered significant. Lengthening the Sacramento Weir and setting back the north levee of the Sacramento Bypass 1,000 feet would not result in any significant adverse effect on visual resources.

Mitigation

Lower American River and Downstream from American River. Adverse effects to visual resources associated with new levee construction and with applying rock revetment to existing waterside levee surfaces could be mitigated, but not to a "less than significant" level, by ensuring that the outer layer of the affected levee surfaces are covered with soil and hydroseeded. Adverse effects associated with the new pumping facilities at Mayhew Drain and Buffalo Creek could be mitigated with landscape plantings, but not to a "less than significant" level.

CUMULATIVE IMPACTS

The cumulative impacts discussion for the stepped release Plan is in chapter 10 where a combined cumulative impacts analysis compares this plans potential cumulative impacts with other ARP plans and other water resource projects for their cumulative effects on high value riparian and wetland habitats. Growth-inducing impacts are also in chapter 10.

SUMMARY OF IMPACT CONCLUSIONS AND ENVIRONMENTAL COMMITMENTS

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

The CEQA Guidelines state that any significant environmental effects which cannot be avoided if the proposal is implemented must be described. This description extends to those significant effects which can be mitigated but not reduced to a level of insignificance. All potentially significant adverse effects associated with implementation of the Stepped Release Plan, as indicated by the preceding evaluation, can be avoided or mitigated to level of insignificance. Construction activities at Folsom Dam would result in a significant unavoidable increase in noise during the construction season.

SIGNIFICANT IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

No significant irreversible environmental changes would result from the Stepped Release Plan, since this alternative would not commit nonrenewable resources to uses that future generations would be unable to reverse. Folsom Reservoir operations could always be returned to the Base Condition should that become the prudent course of action.

SHORT-TERM USES OF THE ENVIRONMENT VS. LONG-TERM PRODUCTIVITY

Provision of a increased flood protection to substantial portions of the Sacramento Metropolitan Area would contribute to the long-term economic productivity of the region. This benefit would be achieved without any significant sacrifice of environmental resources, since the adverse impacts of this alternative are temporary and would not result in long-term degradation of the physical environment.

EFFECTS FOUND TO BE SIGNIFICANT

The summary table at the beginning of this FSEIS/EIR documents the most salient impact determinations and whether they were deemed significant or less than significant.

ENVIRONMENTAL COMMITMENTS

Significant operational adverse effects and required mitigation would be the same as identified for the No-Action Alternative.

- Potentially significant effects resulting from increased turbidity and possible sitation at spawning areas would be mitigated to a less than significant level by requiring that construction sites along the American River Parkway be fully contained by barriers and dikes to reduce any chance that sediment or fluid from construction machinery enter the waterway.

- Effects to seasonal wetland/marsh habitat could be reduced to a less-than-significant level by restoring 56 acres of this habitat type on Liberty Island in accordance with FWS recommendations.

- Adverse effects to vegetation from construction activities would be compensated by a replanting program along the lower American River and on Liberty Island. This includes planting 75 acres of oak woodland and 98 acres of riparian vegetation. Along the lower American River, riparian cover will be compensated on a 38-acre site at river mile 3.7. For oak-woodland, 75 acres would be provided at one site near rived mile 15. For areas downstream from the American River, riparian and wetland losses will be compensated on 116 acres at Liberty Island. Oak-woodland compensation is proposed at the same mitigation site near river mile 15 as recommended for compensating oak losses along the lower American River.

- FWS compensation guidelines would be followed for the valley elderberry longhorn beetle.

- Seasonal restrictions on construction activity would be in accordance with DFG guidelines to avoid effects to Swainson's hawk.

- Seasonal restrictions on construction activities would be in accordance with DFG guidelines to avoid affecting the giant garter snake.

- Contractors would prepare a transportation plan and traffic engineering studies, if necessary. Where possible, traffic would be rerouted.

- A dust suppression plan for the construction areas would be prepared and implemented. An Air Quality Conformity Plan would be prepared and coordinated with the SMAQMD. A detailed general conformity analysis would be conducted should this plan be selected for implementation.

- To avoid or reduce the increase in ambient noise levels, the construction equipment would be equipped with appropriate mufflers, and stationary sources would be shielded. The increase in noise levels from construction and quarrying would result in significant and unavoidable effects that may not be mitigated to a less than significant level. This impact is temporary and would only last for the duration of the construction.

- Mitigation for operation effects from permanent reoperation of Folsom Dam are covered by an adaptive management plan that would reduce reoperation-induced effects to a level of insignificance.

CORPS RESPONSES TO FWS RECOMMENDATIONS

The U. S. Fish and Wildlife Service (FWS) submitted a revised draft Supplemental Fish and Wildlife Coordination Act (FWCA) report for the (ARWP) American River Watershed Project in July 1995. The report supplements the FWS 1991 FWCA report. The entire section of FWS recommendations is presented below, with Corps responses below each recommendation.

> The recommendations contained within this section constitute what the Service believes, from a fish and wildlife resource perspective and consistent with our Mitigation Policy, to be the best present recommendations for the project. The outcomes of any new or renewed consultations, as required under Section 7 of the Endangered Species Act or the Fish and Wildlife Coordination Act, could also affect the recommendations herein.
>
> The Council on Environmental Quality and the Service's Mitigation Policy define mitigation as including the following elements: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts. The Service considers these elements to represent the most desirable sequence of steps in the mitigation planning process. In determining when to move from any one element to the next in the sequence, success or failure of particular techniques or approaches in the past under similar circumstances (as reflected in the results of previous (e.g., DeWeese 1994) mitigation evaluation studies) are taken into account. The FWS preferred alternative for mitigation of project impacts is to avoid them altogether. Following are our recommendations for 1) actions relative to the American River Watershed Investigation as a whole, 2) actions specific to the Stepped Release Plan, and 3) actions specific to the Detention Dam Plan.

GENERAL RECOMMENDATIONS

FWS Comment: We recommend that adverse impacts be minimized by selecting a flood control alternative which avoids unmitigatable impacts to fish and wildlife resources. At present, this plan would be either increased Folsom Modification or the Stepped Release Plan.

Corps' Response: The non-Federal sponsors of the project, the Sacramento Area Flood Control Agency and the State of California Reclamation Board, in conjunction with the Corps, have thoroughly considered all the alternative plans, including the Folsom

Modification Plan and the Stepped release Plan. Based on final recommendations of governing boards and headquarters review, the project proponents have selected the Detention Dam Plan as both the NED plan and the locally preferred plan. Regardless of the plan selection, full compensation, to the extent practicable, will be provided.

FWS Comment: The following recommendations are provided pursuant to Section 7 of the Endangered Species Act.

a. Determine potential effects of the project on listed or proposed species or critical habitat by conducting surveys for the species or potential habitat, as appropriate.

b. Should the species or critical habitat be present, complete a Biological Assessment for the project and determine whether the species would be affected.

c. Should the proposed action be likely to affect the species or its critical habitat, initiate formal consultation with the Service.

Corps' Response: The Corps has initiated formal Section 7 consultation by forwarding a Biological Assessment to FWS. Recommendations that would reduce the likelihood of listed species being adversely affected by the project are also included in the Corps' Biological Data Report (appendix K).

STEPPED RELEASE PLAN

FWS recommends that the following actions be fully considered singly or in combination by the Corps as refinements to the proposed Folsom storage/stepped release plan for impact avoidance:

FWS Comment: Reevaluate the levee modification design along the lower American River to ensure that modification features are necessary to meet intended flood control objectives. As discussed earlier in this report (with-project conditions), these areas include 1) the floodwall downstream from the Nimbus Fish Hatchery, 2) new levee construction on the south bank of the river opposite William B. Pond, and 3) new levee construction along the Gold River area. Deleting project features in these areas could reduce mitigation needs for woody vegetation by about 30 acres.

Corps' Response: At the request of FWS, the alignment of the floodwall and new levees was moved from the original location to avoid sensitive areas. Deleting project features in these areas would likely reduce mitigation needs; however, the Corps' evaluation of the levee modification design concludes that the proposed floodwall and new levee construction features are necessary to carry the increased objective releases. The Corps proposes to mitigate for the affected areas.

FWS Comment: For the hydraulic mitigation area, eliminate proposed borrow sites which now contain woody vegetation, and select lower value habitat areas for extracting borrow material.

Corps' Response: The present acreages of native habitats in the hydraulic mitigation area (downstream from the American River) are relatively small in relation to the agricultural acreages. The Corps has reevaluated its borrow site selections in the hydraulic mitigation area and has eliminated planned use of borrow sites that contain woody vegetation (oak) and has opted to use the Cache Creek Settling Basin borrow site, which has much lower value habitat.

FWS Comment: Modify Corps levee maintenance regulations to allow tree growth on existing (and proposed) levees, thereby reducing impacts to riparian forest, riparian shrub, and oak-woodland habitats.

Corps' Response: Grassland and herbaceous acres that are disturbed for levee improvements will be reseeded with native vegetation. Impacts to riparian forest, riparian scrub, and oak woodland habitats will be mitigated through a compensation plan which includes revegetation. The Corps' regulations on levee maintenance do not allow woody vegetation to be planted on levee slopes due to the need for rapid inspection of the slopes during storms for possible erosion, sloughing, and piping and also because roots from large plants can create a seepage path through the levee, which can lead to failure.

FWS Comment: Modify the alignment of the floodwall across from Goethe Park to avoid impacts to mature oak-woodland habitat.

Corps' Response: As noted above, the floodwall alignment has been refined and shortened; however, a floodwall across from Goethe Park remains a necessary component of the Stepped Release Plan. A further attempt would be made to avoid affecting oak-woodland habitat by modifying the alignment of the floodwall during final design, should this alternative be authorized.

FWS Comment: Address any impacts (to listed and non-listed species) resulting from project-induced agricultural or urban development within the appropriate environmental documentation for this project. Initiate the appropriate consultation with the Service, as required under the Endangered Species Act, for such potential effects on listed species.

Corps' Response: In compliance with the California Environmental Quality Act (CEQA), the Corps has addressed all potential direct, indirect, project-induced growth, and cumulative impacts in the FSEIS/EIR. The Corps has also properly initiated the process required by Section 7 of the Endangered Species Act by submission of the Corps' Biological Assessment to FWS.

FWS Comment: To compensate the elimination of 25 acres of riparian forest and shrub that would result from project construction along the lower American River, plant 45 acres of

native woody riparian vegetation at optimum densities at the Woodlake site in the American River Parkway.

Corps' Response: Based on the results of the revised draft CAR to compensate for 24 acres of riparian forest and shrub, 38 acres of woody riparian habitat would be planted at the Woodlake site.

FWS Comment: For impacts to 64 acres of riparian forest and shrub in the hydraulic mitigation areas, plant 67 acres of these habitats in the hydraulic mitigation area at Liberty Island.

Corps' Response: The Corps has identified a site at Liberty Island as a potential mitigation area. A 116-acre portion of Liberty Island has been proposed as a site for riparian forest/shrub, and emergent marsh habitat mitigation. The incremental analysis determined that the most cost efficient mitigation method is to plant 60 acres of riparian forest and shrub habitats at this site.

FWS Comment: To fully compensate impacts to 9.7 acres of SRA cover along 6 miles of sloughs in the hydraulic mitigation area, 25.6 acres of shaded-riverine habitat would need to be planted along at least 16 miles of project sloughs at an approximate 13-foot width to regain lost habitat values. This plan would also mitigate for a portion of the losses of riparian habitat.

Corps' Response: Due to the very high habitat value associated with SRA, waterside revetment work on levees along sloughs in the Yolo Bypass has been eliminated from the construction plans. New designs will allow the levees to be strengthened by adding material on the landward side in the same manner as other levee strengthening in the bypass. This design change eliminates any impacts to SRA habitat and thus eliminates any SRA mitigation needs.

FWS Comment: For the lower American River, mitigate the loss of 14 acres of oak woodland habitat by planting 56 acres of oak tree species in the American River Parkway. Two sites at about river mile 15, one being one of the Corps' proposed borrow sites, would be suitable.

Corps' Response: The Corps concurs with this recommendation. However, mitigation requirements have been revised because oak impacts from project construction in the Yolo Bypass are less, so the few acres of remaining oak compensation will be combined with the oak plantings proposed for the borrow site near Cordova Park close to river mile 15, thus the need for a second oak mitigation site in this area was eliminated.

FWS Comment: For impacts to 15 acres of oak woodland in the hydraulic mitigation area, 52 acres of this habitat would need to be planted.

Corps' Response: Because oaks at the originally proposed borrow sites in the upper Yolo Bypass will not be destroyed, an oak mitigation site in the Cache Creek Settling Basin is no longer needed. As such, no mitigation is now planned for the Cache Creek Settling Basin. The remaining oak impacts due to widening the Sacramento Bypass will be mitigated at the lower American River oak mitigation site near Cordova Park.

FWS Comment: In the hydraulic mitigation area, mitigate the loss of 43 acres of permanent freshwater emergent marsh habitat by replanting 47 acres of emergent marsh species on low habitat value cropland as described in the HEP report.

Corps' Response: The Corps has identified Liberty Island as a mitigation area. A portion of Liberty Island has been proposed as a site for riparian forest/shrub and emergent marsh habitat mitigation. As recommended, 47 acres of emergent marsh species would be planted at the Liberty Island site.

FWS Comment: Also in the hydraulic mitigation area, mitigate the loss of 8 acres of seasonal freshwater emergent marsh habitat by replanting native species on 9 acres of low habitat value cropland as described in the HEP report.

Corps' Response: The Corps has identified Liberty Island as a possible mitigation area. A portion of Liberty Island has been proposed as a site for riparian forest/shrub and emergent marsh habitat mitigation. As recommended, 9 acres of native emergent marsh species would be planted at this site

FWS Comment: Mitigate losses to annual grassland by reseeding construction areas, including staging and borrow sites, with grasses (native species when possible).

Corps' Response: The Corps concurs with this recommendation.

FWS Comment: Develop detailed mitigation, monitoring, and remedial action plans for each mitigation action and site. Coordinate all phases of mitigation plan development and implementation with the Service and DFG.

Corps' Response: A mitigation and monitoring program, as required by CEQA, has been developed by the Corps, SAFCA, and the State and is contained in Volume 4, Appendix H.

FWS Comment: Have staff with biological expertise monitor construction activities and provide technical assistance to ensure avoidance of additional construction impacts.

Corps' Response: The Corps concurs with this recommendation.

CHAPTER 9

ENVIRONMENTAL CONSEQUENCES DETENTION DAM PLAN

This plan consists of five main elements: (1) constructing a flood detention dam along the North Fork of the American River at river mile 47.2, just downstream from the confluence of the North and Middle Forks of the river near the site of Reclamation's partially constructed multipurpose Auburn Dam; (2) relocating Highway 49 and the Ponderosa Way bridge; (3) reverting flood control operations at Folsom Reservoir to governance under the 1986 Diagram; (4) raising and strengthening 12 miles of levee along the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River; and (5) constructing a seepage cutoff wall into the core of the Federal and non-Federal levees along both sides of the lower American River.

The top of the detention dam would span the North Fork canyon at elevation 998 (508 feet above the streambed). At this elevation, the dam would be 2,700 feet wide, creating a storage capability of up to 894,000 acre-feet. Flood control releases would be made through 20 gates which would be operated to reduce storage of fairly frequent events and retard the drawdown of large floods to reduce the potential for soil slippage along the canyon walls bounding the 5,400-acre inundation zone. The dam would contain a 540-foot-wide spillway (crest elevation 942 feet) and flip bucket (lip elevation 589 feet) for releases if floods exceeded the dam's storage capacity.

The detention dam would be designed not to preclude subsequent expansion of the facility into a multipurpose project providing permanent water storage and related water supply, hydropower, flatwater recreation, and instream flow benefits. Such an expansion would require separate congressional action based on appropriate environmental review of the impacts of permanent water storage in the project area. Expansion of the detention dam to a multipurpose facility is discussed further in chapter 10.

To accommodate the flood control storage pool while maintaining current access across the North and Middle Fork canyons between Placer and El Dorado Counties, this alternative provides for an in-kind replacement of the two-lane Highway 49, which traverses the project area just upstream from the confluence of the North and Middle Forks of the river. At its lowest elevation, this bridge crossing is approximately 100 feet above the streambed at about elevation 600 feet. The highway would thus be subject to inundation that would periodically cut off all travel through the project area. For purposes of the environmental analysis which follows, it is assumed that the replacement highway would be

aligned slightly upstream from the existing alignment at an elevation sufficient to clear the maximum height of the flood control pool. However, as discussed below, the actual alignment of the replacement highway would require completion of a route adoption study by State and Federal highway officials.

Operation of the detention dam would result in infrequently inundating the canyon. When this occurs, the Ponderosa Way bridge would be flooded. To prevent damage to this structure and to prevent it from being swept off its foundation, the bridge would be modified and stabilized in its present location.

Upon completion of the detention dam, flood control operations at Folsom Reservoir would revert to governance under the 1986 Diagram. Under this diagram, seasonal flood control storage at Folsom would be fixed at 400,000 acre-feet, and flood control releases from the reservoir would be maintained at a maximum of 115,000 cfs.

To optimize system operations, a cutoff wall would be inserted into the core of the Federal and non-Federal levees for approximately 24 miles along both sides of the lower American River.

To optimize protection for the Natomas area, 12 miles of the east levee along the Sacramento River would be raised and stabilized.

The Detention Dam Plan would result in a number of operational and construction impacts, identified below with appropriate mitigation measures to reduce the identified impacts to a "less than significant" level. Following this discussion is a summary of the cumulative and growth-inducing impacts.

OPERATIONAL IMPACTS

The operational impacts of concern in connection with the Detention Dam Plan are those related to the effects on recreation; fish, vegetation, and wildlife resources, including threatened and endangered species; cultural resources; and transportation, resulting from periodic storage of floodwaters in the North and Middle Fork canyons in the upper American River project area. In addition, reverting Folsom Reservoir flood control operations to governance under the 1986 Diagram would have beneficial effects for water supply, hydropower, and recreation at Folsom (table 9-1). These operational impacts are evaluated below.

TABLE 9-1

Comparison of Projected Peak Outflows From Folsom Dam for Selected Flood Events

	Alternatives	
	No-Action Alternative 400/670 115,000 cfs (objective release)	Detention Dam 400,000 115,000 cfs (objective release)
5-Year		
Peak	60,000	60,000
Duration ≥ 25,000	3 days	3 days
10-Year		
Peak	90,000	90,000
Duration ≥ 25,000	4 days	4 days
20-Year		
Peak	115,000	115,000
Duration ≥ 25,000	5.5 days	5.5 days
50-Year		
Peak	115,000	115,000
Duration ≥ 25,000	10 days	10.5 days
100-Year		
Peak	115,000	115,000
Duration ≥ 25,000	15 days	15 days

WATER SUPPLY

No-Action Condition

Folsom Reservoir would be operated to reserve 400,000/670,000 acre-feet of storage space annually. Between 400,000 acre-feet and 670,000 acre-feet of storage would be provided from mid-November to mid-March, depending on precipitation. This would have some minor effects on delivery of local water supply. This increased flood storage capacity would also result in an average slight reduction (about 5,000 acre-feet) in the total winter deliveries of the CVP and average lower water storage in Folsom of 40,000 acre-feet.

Impacts

Operation of the detention dam would benefit the water supply capabilities of the CVP/SWP. Returning the operation of Folsom Reservoir to 400,000 acre-feet of reserved flood storage space from 400,000/670,000 would have the benefit of reducing the required winter drawdown by as much as 270,000 acre-feet during certain years. This would have

some minor benefits to local and CVP/SWP water supply deliveries, since the water level would on average be slightly higher during the winter. The benefits would be most noticeable at Folsom, but effects would be felt at other CVP/SWP facilities. The decreased storage requirement would result in returning the amount of water available for delivery into the CVP/SWP to the quantities prior to reoperation of the system, eliminating the obligation of replacing these annual water losses.

Mitigation

No mitigation would be required.

HYDROPOWER

No-Action Condition

As discussed for water supply above, Folsom Reservoir would be operated to reserve 400,000/670,000 acre-feet of storage space on an annual basis.

Impacts

Operation of the detention dam would benefit the hydropower capabilities of the CVP/SWP. Returning the operation of Folsom Reservoir to 400,000 acre-feet of reserved flood storage space from 400,000/670,000 would have the benefit of reducing the required winter drawdown by as much as 270,000 acre-feet during certain years. This reduction would have some minor benefits on hydropower deliveries, since the water level would on average be slightly higher during the winter months. The benefits of this would be most noticeable at Folsom, but effects would be felt at other CVP/SWP facilities. Decreasing the storage requirement would result in returning the amount of water available for generating hydropower to the quantities which existed prior to reoperation of the system. This would eliminate the obligation of replacing these power losses, estimated at approximately 12 GWh per year and 4 MWh per month. In addition, up to 14,000 acre-feet of CVP/SWP water deliveries would be replaced per year.

Mitigation

No mitigation would be required.

RECREATION

No-Action Condition

Reclamation contracted with the Department of Parks and Recreation to provide recreation and public-use management services on the lands within the boundaries of the multipurpose Auburn Dam project, known as the ASRA (Auburn State Recreation Area). The ASRA includes 42,000 acres and 48 miles of the American River, extending from the damsite upstream beyond the project boundary to the Iowa Hill bridge on the North Fork to Oxbow Reservoir on the South Fork.

Its nearness to major population centers and diverse recreation base make the ASRA one of the most used and significant recreation resources in northern California. Local interest in recreation is very heavy. Bicycling has increased dramatically in the area. There is continuing demand for equestrian and other trails. The Tevis Cup horse race and the Western States Run, both 1-day, 100-mile events, use the Western States Trail from Auburn to Squaw Valley. These events draw entrants from around the world. Whitewater boating on the Middle and North Forks of the American River is of State and national significance. Both forks offer overnight camping opportunities, hiking trails, cultural and natural observation sites, and a diversity of difficulty in whitewater rapids from beginning to advanced boating skill levels. The nearby South Fork of the American River offers a less challenging whitewater experience, and because of the predominance of private lands and development along the river corridor, camping is restricted. The nearest similar "wilderness" whitewater river providing overnight trips is the Tuolumne River about 100 miles southeast of the recreation area.

Approximately 72 miles of hiking trails, 66 miles of equestrian trails, and 15 miles of fire road are open to mountain bikes in the ASRA and provide year-round recreation opportunities. The trails and roads include Manzanita Trail, Middle Road Trail, Pointed Rock Trail, Old Quarry Road Trail, Tinkers Cutoff, Old Stage Road, Old Auburn-Foresthill Road, a number of other trails, and many mountain bike trails. Additionally, the Western States Trail has been included as the trans-Sierra route of the proposed coast-to-coast American Discovery National Trail. Potential adverse effects of periodic inundation to No Hands Bridge may reduce its structural integrity.

The Department of Parks and Recreation has the responsibility for maintaining these trails; due to budget constrains, maintenance that is conducted is accomplished by volunteer workers, usually associated with the Western States Endurance Run.

Folsom Reservoir supports numerous water-based activities such as boating, waterskiing, and fishing. The shoreline provides sandy swimming beaches, both formal

(with lifeguard services) and informal. Surrounding Folsom Reservoir is a landscape with important scenic, natural, and cultural values. Recreational facilities include camping and picnic areas, boat launch ramps, restrooms, concessions, bicycle and mountain bike trails, and equestrian trails and staging areas. Operational impacts to recreation are discussed in detail under the No-Action Alternative, chapter 6.

Significance Criteria

Impacts on boating, swimming, fishing and wading were considered significant if changes in flows or water temperature would result in a 10 percent reduction in recreational use when compared to the No-Action Alternative. Changes in the quality, such as visual quality, of the recreation experience were considered in assessing the significance of effects to recreation in the American River canyon.

Impacts

Folsom Reservoir. Returning the operation of Folsom Reservoir to 400,000 acre-feet of reserved flood storage space from 400,000/670,000 would have the benefit of reducing the required winter drawdown by as much as 270,000 acre-feet during certain years. This would have some minor benefits on recreation, since the water level would generally be slightly higher during the winter. By reducing the requirement that the reservoir be drawn down so far during very wet winters, the reservoir would be more likely to refill to capacity each recreation season. Recreational boaters would therefore have a longer and more enjoyable season.

Upper American River. This discussion focuses on three potential operational impacts: (1) reduced access to canyon recreation opportunities due to the potential abandonment of old Highway 49, trail washouts, and the infrequent, temporary inundation of up to 40 miles of the North and Middle Fork canyons during the flood season; (2) potential decline in the visual quality of the canyons due to the physical presence of the dam, the potential for vegetative losses due to inundation mortality, and the potential for a scarring of canyon walls within the inundation zone due to reservoir-induced soil slippage; and (3) disruption of boating facilities at Lake Clementine due to periodic inundation.

Damage sufficient to substantially reduce or eliminate use of any major roads or trails would constitute a significant impact. The primary recreation impact would result from infrequent temporary inundation of the river up to an elevation of 942 feet. This inundation would likely be during mid-winter (December-February) rainstorms. Over time, however, this periodic inundation would result in changes in the density of vegetation along the forks of the river and at Lake Clementine due to accelerated mortality. This type of impact is more fully discussed under the section in this chapter on operational impacts to vegetation and wildlife. This inundation could increase soil instability along the walls of the canyon,

primarily at trail and road cuts, causing sloughing in portions of the inundation zone. It should be noted that much of this type of sloughing at road cuts and trails presently occurs under the without-project condition during winter storms. Trail slippage or blocked trails could create public safety concerns and affect recreation use. Inundation of the upper American River might cause floating debris such as logs, limbs, and sediment to be deposited on roads, trails, or other recreation sites and cause disruptions until maintenance crews could clear the obstructions. It is also possible that some trails, including the Western States Trail, could wash out along lower-lying trail alignments. Although minor, these individual impacts, when added together, would constitute a significant effect.

Because most of the recreation in the upper American River is tied directly to water access, recreation would not be disrupted by minor changes in vegetation or the visual resource base. Consequently, adverse effects to visual resources in the area would not constitute a significant adverse effect to recreation. Adverse effects to visual resources due to operation are unavoidable, and onsite mitigation is not feasible; however, the adaptive management plan would include replacement of plants and limited repair of trails following inundation.

Adverse changes in vegetation and visual resources, which may reduce the value of the fishing experience, are not expected to substantially reduce the fishing effort in the upper American River area. The Adaptive Management Plan would (1) maintain some access to fishing sites as maintenance crews assess vegetation conditions via existing roads, and (2) offset adverse effects to visual resources through replanting of vegetation.

All existing public lands within the project limits would remain in public ownership. It is also assumed public lands outside the flood control pool area, but within Reclamation's 42,000-acre Auburn Dam project boundary, would be retained in public ownership. Reclamation and the Department of Parks and Recreation are expected to continue to manage these lands until a long-term decision is made to develop the resources available at the Auburn site. Thus, no loss of public access to recreation resources would be expected under the project or the without-project condition.

<u>Confluence Area</u>. The confluence area is one of the highest use areas on the upper American River because of its location and access from Highway 49. Recreation from December through February is only about 6 percent of the annual total; the resulting loss of 3,150 visitor days out of over 500,000 would be considered less than significant. This potential loss would occur only after heavy rains when a temporary flood pool is established.

It is not the loss of visitor days that is significant; with proper mitigation, there may actually be an increase in use. The periodic inundation of the canyon by the flood control pool will result in changes in the composition of bank vegetation along the rivers and at Lake Clementine. It is estimated that a 200-year event would create a flood detention pool with a

surface elevation of 923.7, which could last up to 7-1/2 days. In the unlikely event the pool remained at that elevation for more than 7 days, the youngest individuals in the chaparral, interior live oak, and canyon oak communities would experience some mortality. This die-off of a portion of the chaparral and evergreen plant communities would change the overall appearance of the area for the short term. However, replanting accomplished under the Adaptive Management Plan would soon restore the vegetative character.

The majority of recreational use in the project area is directly tied to water access or off-highway vehicle activity, so use will not be significantly affected by these changes in the vegetation or visual resource base. Although use levels may not change, a certain percentage of users will be negatively affected from an experiential perspective.

After Highway 49 is replaced, the responsibility for maintaining the existing, or "historic," portion of the highway into the canyon is expected to be turned over to either Placer or El Dorado County. Access would remain at least initially. However, periodic inundation of the highway could increase maintenance costs associated with repairing the roadway. If costs become prohibitive for the counties to continue needed maintenance, access to the river from the historic roadway could be eliminated.

Lake Clementine. The marina's floating docks, now permitted to the Auburn Boat Club, may be adversely affected by periodic inundation. The gas sales service and existing toilet facilities not capable of withstanding periodic inundation may need to be removed or replaced to prevent contamination of the lake. The existing launching ramp would not be affected.

Upper North and Middle Forks. Project operations would not significantly affect the amount or patterns of recreational use associated with either fork of the river. Though a 400-year flood would create a flood control pool extending approximately 3 miles upstream from Ponderosa Way (the last point for whitewater boating activity on the North Fork), inundation would last less than 6 days during a period of minimal use, with little quantitative impacts. On the Middle Fork, the pool would extend to Buckeye Point and submerge the Greenwood Bridge crossing under approximately 90 feet of water at peak inundation. Although numerous access roads to recreation sites in the upper American River could be temporarily unavailable during inundation, recreation impacts would be negligible, since the flooding would take place during the winter, and recreation use is at its peak during the spring and summer.

Mitigation

Adverse impacts to recreational trails in the inundation area would not be directly mitigated. Only trails required for vegetation monitoring and plant establishment after a storm would be maintained.

Infrequent, temporary impoundments behind the detention dam are not expected to result in the permanent loss of recreation resources upstream from the detention dam. Maintaining the current access from Highway 49 to the Auburn State Recreation Area ensures that activities served by the access such as swimming, fishing, mountain biking, hiking, and picnicking will remain viable in the confluence area of the North and Middle Forks of the American River. Reclamation and the Department of Parks and Recreation are expected to continue to manage these lands until a long-term decision is made to develop the resources available at the Auburn site. Adverse impacts to recreational trails in the inundation area would not be directly mitigated. Only trails required for vegetation monitoring and plant establishment after a storm event would be maintained.

Should periodic inundation render No Hands Bridge structurally unsound, the loss of the recreational use of the bridge would be mitigated for by rerouting trail activities to the crossing of the American River at the nearby existing Highway 49 bridge. Rerouting the trail for this short distance may have an adverse effect on the qualities of the trail associated with crossing the No Hands Bridge, but the functional qualities of the trail would be maintained, and recreational use would not likely decrease.

Impacts to recreation features at Lake Clementine resulting from the periodic inundation during major storms would continue as specified under the lease agreement with the marina operator; the agreement requires removing portable fueling and restroom facilities during the winter when flooding is likely. Because the Lake Clementine area was flooded when Reclamation's cofferdam was operable, permanent facilities or structures have been flood proofed, and no additional work would be required. The floating docks would either be removed during the winter or converted over time to fixed structures.

FISHERIES

No-Action Condition

Historical documentation on fisheries in the area is limited. Currently, year-round resident fishes of the North Fork include several warmwater species, among them smallmouth bass, bullhead, and sunfish. The river has many pools and riffles with gravels suitable for trout and smallmouth bass. But low summer flows and high water temperatures greatly reduce the use of this habitat by coldwater species. Surveys by the FWS on

September 20 to 28, 1989, found 38 fish, including warmwater species such as smallmouth bass, riffle sculpin, Sacramento sucker, Sacramento squawfish, and brown bullhead, while trout were scarce. Lake Clementine contains a similar species composition; however, the Department of Fish and Game periodically plants trout.

Historical records of fish resources in the Middle Fork are limited. Construction of the Middle Fork American River project by Placer County Water Agency resulted in cooler water temperatures in summer and fall and improved habitat suitability for resident and stocked coldwater species, including rainbow and brown trout. In the past, rainbow and brown trout have been stocked in the Middle Fork. Resident fish species in the Middle Fork include Sacramento hitch, Sacramento sucker, Sacramento squawfish, riffle sculpin, and brown and rainbow trout. Fish species that are year-round residents of the North Fork include smallmouth bass, bullhead, sunfish, riffle sculpin, Sacramento sucker, and Sacramento squawfish. Rainbow and brown trout are stocked yearly.

A discussion of the No-Action Conditions for the fishery of the lower American River and Folsom Reservoir is presented under the Folsom Modification Plan. Returning Folsom Reservoir to 400,000 acre-feet of fixed storage would have benefits to fishery resources in the reservoir by stabilizing the lake level, and along the lower river by returning the flow regime to the 1986 operating criteria.

During May and September 1989, FWS biologists surveyed the North and Middle Forks of the American River to observe the aquatic habitat and to determine the types and relative abundance of resident fish. The North Fork supports a variety of warmwater species including smallmouth bass, bullhead, and sunfish on a year-round basis. Although a few trout are present, summer/fall water temperatures are generally too warm for suitable summer rearing. Ongoing instream mining operations and the results of earlier construction at the Auburn Dam site are the most apparent disturbances along the river. The Middle Fork American River, in contrast, supports both warmwater and coldwater species year-round. Cooler temperatures resulting from the Middle Fork American River Project support brown and rainbow trout for about 10 miles below the dam. Habitat is more suitable for warmwater species below this point.

North Fork. Below the Colfax-Iowa Hill Bridge, the North Fork flows through steep-sided canyons with 30-60 percent or greater slopes. Riffles are generally small in area and interspersed between series of deep pools and cascades. All 25 miles surveyed by FWS contain suitable rearing habitat for resident fish. However, low summer flows and high water temperatures reduce habitat suitability for coldwater species.

A total of 58 riffles and 64 pools occur from the Colfax-Iowa Hill Bridge downstream 25 miles to the Auburn Dam site . Forty-three of the fifty-eight riffle areas (77 percent) are in an 8 mile stretch between Shirttail Creek and Lake Clementine. The average riffle is 196

feet long, 82 feet wide and 4 feet deep. The average pool is 246-foot-long, 77-foot-wide and 14-foot deep. The majority of these riffles had significant areas with a combination of gravels from 0.25 to 3.0 inch diameter and underlying cobbles suitable for trout and small mouth bass spawning (Reiser and Bjornn, 1979; FWS 1983, 1984). Sediments covered less than 25 percent of these gravel areas (FWS 1991).

Historical background on fish resources of the North Fork is limited. California Department of Fish and Game records of stream surveys from 1934-1938 prior to Folsom Dam construction indicated that a variety of warm and coldwater species were observed. Post-Folsom Dam surveys in 1965 also included smallmouth bass (Micropterus doloieui) in addition to those found in the 1930's, and densities of approximately 100 trout per mile were observed (FWS, 1991).

Lake Clementine begins about 3.5 miles above the Auburn Dam site and extends 5 miles upstream. Similar fish species occur in the North Fork and in Lake Clementine. The Department of Fish and Game periodically stocks rainbow trout in Lake Clementine. The most recent records for angler use estimate about 5,000 angler-days annually are spent on Lake Clementine (Kennedy Engineers, 1971). Access to lower Lake Clementine is limited due to parking and boat launching space constraints (FWS, 1991).

Below Lake Clementine, there are fewer riffles, and increased sediment deposition is evident. Below the Middle Fork confluence, gravel sizes decrease and sandbar deposits increase. The three-fourth-mile stretch of channel above the Bureau's cofferdam site is covered by sand deposits which accumulated during operation of the cofferdam (FWS, 1991).

Throughout the reach from Colfax-Iowa Hill to Auburn Dam site, fringes of riparian vegetation overhang the channel. Willow, alder, and blackberry are predominant. Large gravel bars are also sparsely vegetated with these species. The steep canyons and narrow channel likely have a much greater influence on water temperature than the overhanging vegetation. Daily incidence of direct sunlight exposure on the river is greatly reduced by the steep and closely adjoining canyon walls (FWS, 1991).

Disturbance of the substrate is evident along most of the river channel, due apparently to numerous instream mining operations. Tailing piles and diversions are common. Surveys (FWS, 1989) indicate that low flows and high temperature in the summer favor greater abundance of warmwater species. Smallmouth bass, riffle sculpin, Sacramento sucker, Sacramento squawfish, and brown bullhead were found in significant numbers in pools and riffles, whereas trout were scarce. A fish sampling survey conducted by FWS along the North Fork American River between September 20-28, 1989, identified 25 smallmouth bass, 2 Sacramento squawfish, 3 riffle sculpin, 3 Sacramento sucker, 3 brown bullhead, 3 green sunfish, and 1 rainbow trout (FWS, 1991).

Sport fishing is concentrated at the major access points along the river (for instance, at the Colfax-Iowa Hill Bridge, Yankee Jim Bridge, Ponderosa Bridge and other vehicle access roads) (FWS 1991).

Middle Fork. From Oxbow Reservoir/Ralston Afterbay downstream to the confluence, the Middle Fork flows through steep-sided canyons of 30 percent or greater slopes. Riparian vegetation comprised of willows, alder, blackberry and some cottonwood overhangs the channel in many places. Similar to the North Fork, the steep canyon walls and narrow stream channel likely influence water temperature more than the overhanging vegetation. Construction of the Placer County Water Agency's Middle Fork American River project in 1962, above and including Oxbow Reservoir, provided much cooler water temperatures during the summer and fall, thereby improving habitat suitability for resident coldwater species (FWS 1991).

Overall, 66 riffles and 67 pools are in this segment of the Middle Fork. The average riffle is 132 feet long, 106 feet wide and 6 feet deep. Riffle areas in the uppermost portion (upper 3 miles) above Kanaka Rapids generally contained cobbles and boulders (10 to 160 inches diameter) unsuitable for trout and smallmouth bass spawning. Below Kanaka rapids, wide beds of gravel of 0.25 inch to 3.0 inches in diameter and larger, with less than 25 percent fines covering the surface, were common. There are also numerous smaller gravel areas in shallow pools, along channel margins, and on inside bends. Suitable spawning habitat for trout and smallmouth bass is present from below Kanaka Rapids to the confluence (FWS 1991).

Evidence of gold dredging and substrate disturbance (tailing piles and turbidity) is common throughout the river segment. Twenty-one active dredges were observed during a 2-day float. The greatest activity and substrate disturbance is in the upper 5 miles from Oxbow Reservoir to Cache Rock, where 15 dredges were observed. Since the survey was conducted at the beginning of the dredging season, dredging activity probably increases greatly through the summer (FWS, 1991).

Historical records of fish resources in the Middle Fork are also limited. California Department of Fish and Game records of stream surveys done in 1938 prior to Folsom Dam construction indicate a variety of species present. In addition, records indicate that rainbow and brown trout were stocked from 1930-49 and then again in the mid-1960's (post-Folsom Dam). Compared to the North Fork, the Middle Fork has a much greater relative abundance of coldwater species versus warmwater species (FWS, 1991).

A fish sampling survey by FWS along the Middle Fork American River between September 20-28, 1989, identified 18 Sacramento hitch, 10 Sacramento sucker, 11 Sacramento squawfish, 2 riffle sculpin, 4 brown trout, 3 rainbow trout; 3 fish could not be identified (FWS, 1991).

In summary, the North Fork American River from the Auburn Dam site to the Colfax-Iowa Hill Bridge contains about 20 miles of free-flowing stream habitat and 5 miles of reservoir habitat (Lake Clementine) suitable for warmwater fish production. Major disturbances appear to have been caused by instream mining and the washed out Auburn cofferdam. In contrast, the Middle Fork American River contains about 24 miles of free-flowing stream habitat suitable for both warmwater and coldwater fish, the coldwater habitat being a consequence of the Middle Fork American River project. Instream mining appears to be a major disturbance factor in this reach (FWS, 1991).

The effects of a 200-year sized detention dam on sediment transport were analyzed to help in the design of the dam and outlet configuration. This draft report (Geomorphic, Sediment Engineering and Channel Stability Analysis, Resource Consultants and Engineering, 1993) compared the base (no-action) condition to a detention dam with 12 sluice gates. This was done to learn how sediment would affect the sluices and gates. This study looked at the quantity and size of the material being transported by the river. Where the material would likely be deposited during high flows under the base and project conditions was also evaluated. As a result of this study, the number of sluices has been increased from 12 to 20. Operation of the gates to minimize drawdown-induced sloughing has been also been added.

The river in the study area is divided into a series of reaches between geologic or manmade features which restrict flows in the channel and cause bars to form from the bedload materials. On the Middle Fork, Reach 1 extends from the upstream limit of the project area at RM 21.0 (near Oxbow Dam) to RM 66.5; Reach 2 extends downstream to RM 62.2, the upstream end of the pool caused by Landslide Rapid; Reach 3 consists of the pool behind Landslide Rapid and extends downstream to RM 61.2 ; Reach 4 extends from Landslide Rapid to Greenwood Bridge at RM 59.3; Reach 5 extends from Greenwood Bridge to the upstream end of the pool formed by Mammoth Bar at RM 54.1; Reach 6 extends downstream to Murderers Gulch at RM 52.4; Reach 7 extends from Murderers Gulch to the confluence with the North Fork at RM 50.3; Reach 7a includes the North Fork up to North Fork Dam; Reach 8 is from the confluence and the damsite at RM 47.2. Approximately 90 percent of the sediment in the project area consists of medium to coarse gravels and cobbles; the remainder are divided between coarse sand, fine gravel, and boulders.

The study estimates that under "normal" conditions, approximately 14,500 tons of sediment are delivered as bedload on an average annual basis in the Middle Fork project area, and the North Fork delivers an additional 1,700 tons. The difference between the amount of sediment delivered by the two forks is a result of the North Fork Dam and Lake Clementine, which traps most of the sediment coming down the North Fork. A total of 16,900 tons is delivered past the damsite annually, showing that the system is degradational, losing approximately 700 tons annually. For detention dam conditions, the annual delivery from the North Fork is reduced to approximately 110 tons, and the amount passing through the dam sluices would be approximately 13,500 tons, indicating that the system would

accumulate approximately 1,100 tons in the study area (Resource Consultants and Engineering, 1993).

During a 200-year storm, the relative sediment balance changes significantly. Approximately 560,000 tons of sediment would be delivered by the Middle Fork and approximately 270 tons would be delivered by the North Fork; of this total, approximately 265,000 tons would be carried past the damsite. This indicates that the project area is aggradational, accumulating about 295,207 tons during a 200-year storm without the dam in place. With a dam in place, the North Fork would deliver approximately 40 tons, and the amount passing the damsite would be 70 tons, increasing the aggradation to 560,000 tons. Given the tendency for material to accumulate upstream from constrictions such as Mammoth Bar and channel blockages such as Landslide Rapids or the detention dam, it is likely that sedimentation and bar formation would continue at the same general locations in the future whether or not the project is in place. The exact location and quantity of sediment deposited would be greater with the dam in place (Resource Consultants and Engineering, 1993).

The number of sluices was increased from 12 to 20, and operation of the gates was also added to minimize the impacts to the riverine resources such as the existing riffle pool complex along the river and impacts to vegetation on the canyon walls from drawdown induced sloughing during an inundation event.

The change in design and operation of the dam has made the without- and with-project conditions much closer, significantly reducing the effects of sedimentation on the aquatic environment and the limited fisheries resources in the project area. With a dam in place, sediment would be transported during the early part of a storm when the water is contained in the stream channel. As flows increase and the water begins to back up behind the dam, sediment in the water would start to settle out. When the storm passes and the drawdown begins, the flow rate would accelerate as the water returns to the channel. This acceleration of flows would again transport sediment downstream until the velocities were not sufficient to move the bedload. The second episode of sediment transport would somewhat cleanse the material deposited during the impoundment.

During February 1986, a 2-day average flow of 46,000 cfs was measured at the Foresthill gaging station, and water depths of 30 feet were noted at high-water marks on the canyon wall. Flows were estimated to have velocities of 20 to 25 feet per second. This storm was calculated to have a return frequency of about a 67-year storm. During a 200-year storm, it is calculated that peak inflows past the damsite would be about 300,000 cfs. Model runs indicate that this would result in water depths of approximately 60 feet. For a 400-year storm, peak inflows would be about 510,000 cfs and water depths about 68 feet. Flows of this magnitude would likely result in all but the most sheltered fish being swept out of the river into Folsom Reservoir. Flows of this magnitude would also

cause the cobbles and sediment in the riverbed to move and be redeposited into new bars or at the existing bars along the river

Significance Criteria

For purposes of this evaluation, fisheries impacts were considered significant if operation of the project would substantially interfere with the movement of any resident or migratory fish, substantially diminish habitat for fish, or involve discharge of material which poses a hazard to fish.

Impacts

Operation of the detention dam would not result in any adverse impacts to fisheries in the upper or lower American River. The flows in the river would not be altered except during storms having a return frequency of greater than 1 chance in 20 in any given year (a 20-year storm). Storms greater than that would be temporarily ponded behind the structure and released at a rate sufficiently slow to prevent drawdown-induced sloughing. Flows in the river during storms would continue to reconfigure the streambed upstream from the ponded area, and when the stormwaters recede, the velocities in the streambed would accelerate and cleanse the gravels and cobbles present.

The ponding of waters during extreme storms would generally prevent velocities which would otherwise be sufficient to adversely affect resident fishes. The reworking of the riverbed prior to ponding and during the drawdown phase of a storm would ensure that spawning areas throughout the North and Middle Forks would remain available for the foreseeable future.

There would be no adverse operational impacts to the fisheries resources in the lower American River from restoring operation of Folsom Reservoir to the fixed storage of 400,000 acre-feet which existed prior to implementation of the agreement between SAFCA and Reclamation.

VEGETATION AND WILDLIFE

No-Action Condition

The study area serves as a transition zone between middle elevation foothill grassland; hardwood woodland and forest communities; and the higher montane, largely evergreen conifer-dominated forest communities. This wide range of physiographic and microclimatic environments provides a diverse and complex vegetation mosaic. Forest dominants in the study area vary among deciduous broadleaved trees, evergreen broadleaved trees, evergreen

coniferous trees, and other combinations. Riverine riparian vegetation along the main river corridor includes large areas of flowing open water, rocky shoreline, sand and gravel bars, river-edge willow and shrub thickets, many stands of tall moist forest of varied ages, higher terrace grasslands, and mixed riparian thickets.

Conditions for the lower American River area and the area downstream from the American River are presented in chapters 7 and 8 under the sections discussing construction impacts to vegetation and wildlife.

Cover Type Descriptions. Habitat in the canyons upstream from the proposed damsite includes the specific cover types identified by FWS in 1991 for the HEP. Scammell-Tinling and Knudsen (1991) identified inclusive vegetation cover types for use in their Habitat Evaluation Procedures (HEP) study of the ARWI study area. Seven of these cover types grow between 490 feet msl and 1,135 feet msl in the flood control dam inundation area. They are (in descending order of dominance):

- evergreen-hardwood woodland (south slope oak woodland),
- evergreen-hardwood forest (north slope black oak forest),
- riverine/riparian
- conifer forest,
- chaparral,
- grassland-savanna, and
- rocky/ruderal.

The composition and condition of each plant community varies from site to site. The type and characteristics of vegetation at any given site are influenced by elevation, slope, aspect, soil type, natural history events, and human disturbances. Approximately 84 acres of upland vegetation types (below the 800-foot elevation) were lost or converted to lower quality cover types in 1973-86 through soil erosion and slippage caused by operation and the 1986 failure of the cofferdam at river mile 20.1 (U.S. Fish and Wildlife Service 1991). The acreages of each plant community in the inundation area were provided by USFWS in 1991.

The following sections briefly describe each plant community.

Evergreen-Hardwood Woodland (South Slope Oak Woodland). This community typically occurs on southwest- to south-facing slopes with shallow to moderately deep soils. The canopy is moderately open (30 to 50 percent cover). The most common dominant trees are interior live oak and canyon live oak. Other dominant trees include black oak, blue oak, California bay, and ponderosa pine. Understory composition varies with site conditions. Relatively dry sites have an understory of grassland, which at lower elevations, intergrades with grassland-savannah. Relatively moist sites may support poison oak, deer

brush, styrax, coffeeberry, buckeye, ceanothus, manzanita, clematis, pipevine, and various grasses and forbs (U.S. Fish and Wildlife Service, 1991).

Evergreen-Hardwood Forest (North Slope Black Oak Forest). This community typically occurs on north-facing slopes and in other deeply shaded canyon sites. The canopy is dense (50 to 100 percent cover) and mostly 50 to 100 feet high; occasional conifers are over 200 feet tall. The most common dominant trees are canyon live oak and interior live oak. Other dominant trees include black oak, blue oak, California bay, Douglas-fir, ponderosa pine, and madrone. Some of the largest trees grow in steep, moist drainages with dense woody understory (U.S. Fish and Wildlife Service, 1991).

The amount and type of understory vegetation varies greatly with site conditions. Densely shaded sites often have forest litter or bare soil with little understory vegetation. Some low elevation sites have a groundcover of grassland. Sites with moderate shading and moisture availability may support young forest trees and the same shrubs and vines listed for evergreen-hardwood (south slope) woodlands (U.S. Fish and Wildlife Service, 1991).

Riverine/Riparian. Several riparian vegetation types occur along the main stem river corridor above and below the confluence with the Middle Fork, including palustrine forest, dense thickets, and thin strands of palustrine scrub-shrub habitat; areas of frequently inundated grasses and ruderal herbs; and small patches of emergent marsh on backwaters and isolated ponds. Freshwater marsh also occurs at the lower ends of some wet meadows and in some of the small tributary canyons. All these habitats have been grouped together in the river/riparian category.

Riparian vegetation in the study area is most abundant along the Middle Fork; lesser amounts occur in the North Fork and below the confluence (U.S. Fish and Wildlife Service, 1991). Palustrine forest is dominated by white alder, Fremont cottonwood, box elder, western sycamore, bigleaf maple, and Oregon ash. Palustrine scrub-shrub is dominated by willows, button bush, and coyote brush (Knudsen, 1991). Emergent marsh areas along the rivers are dominated by cattails, tules, rushes, and sedges (U.S. Fish and Wildlife Service, 1991).

Conifer Forest. Mixed conifer forest grows mostly in the eastern portions of the study area, where stands dominated by ponderosa pine and Douglas-fir occur primarily on north-facing slopes. Conifer forest in the western portion of the study area is limited to small patches dominated by ponderosa pine, foothill pine, or knobcone pine. Other conifers that are common elements of the Sierran mixed conifer forest are rare or absent within the study area (U.S. Fish and Wildlife, 1991).

Chaparral. Chaparral grows on dry, well-drained, shallow soils, often on steep south-facing slopes and ridge-tops. Chaparral is most abundant on south slopes in the

canyon of the Middle Fork, where it occurs on limestone, serpentine, or gabbro soils. The evergreen woody shrubs that constitute this vegetation type are well adapted to fire and are very effective at holding the soil on steep slopes. The cover is usually very dense and difficult to penetrate. Understory vegetation is usually sparse or absent.

Dominant species in the study area include chamise, whiteleaf manzanita, ceanothus, toyon, and shrubby forms of interior live oak and canyon live oak.

Grassland-Savanna. This community occurs where woody vegetation is absent or constitutes less than about 30 percent of the cover. Grassland vegetation is the groundcover in some areas of relatively dry evergreen-hardwood forest. Savanna occurs in some areas that are transitional between forest or woodland and open grassland (U.S. Fish and Wildlife, 1991). Dominant species are nonnative grasses and forbs, such as bromes, wild oats, annual fescue, wild barley, filaree, clover, yellow star-thistle, and Italian thistle. Many native grassland species are also present in smaller amounts, including California poppies, lupines, brodiaeas, and tarweeds.

Rocky/Ruderal. This category includes barren, disturbed, or eroded areas that have little or no vegetation. Some of these areas were vegetated before the erosion and slope slippage caused by operation and failure of the cofferdam in February 1986 (U.S. Fish and Wildlife Service, 1991).

Specifically, the north slope forest cover type provides a dense tree habitat with undisturbed drainages for nesting and denning. Species found in this habitat include ringtail cat, grey fox, deer, owls, and many songbird species (FWS, 1991). Thick ground litter provides habitat for amphibians, reptiles, and invertebrates. The ground litter also provides habitat for woodrats and ground-foraging birds. In contrast, the south slope forest is a relatively dry open area in which some of the same species of the north slope forest intermix with species more exclusive to the south slope habitat. These species include turkey vulture, bandtail pigeon, scrub jay, acorn woodpecker, and various warbler species, California thrasher, and various species of vireos and sparrows (FWS, 1991). Additionally, the open, sunny exposures and rocky outcrops provide habitat for the western fence lizard and other species of snakes and lizards.

The drier digger pine conifer forests provide habitat for overlap species from the nearby chaparral such as gray fox, coyote, deer, wood rat, wrentit, scrub jay, thrasher, brush mice, badger, and bobcat (FWS, 1991). The more mesic ponderosa pine and incense cedar stands often support red fox, porcupine, mountain lion, raccoon, beaver, deer mouse, California vole, mink, and forest birds such as Townsend's solitaire, pine siskin, gnatcatcher, nuthatch, western wood pewee, various thrushes, warblers, and grosbeak (FWS, 1991).

The chaparral cover type is usually a fire-adapted type of habitat that can vary greatly in its value to wildlife. Dense stands with little ground vegetation and almost complete canopy closure present low value to wildlife compared to a recently burned area with open areas and young plants and shrubs for foraging. In the Auburn area, chaparral areas are not usually allowed to experience the natural fire regime because of fire avoidance and prevention. Therefore, the chaparral areas are indirectly allowed to mature to decadent, essentially monoculture stands of one or two dominant shrubs with relatively low wildlife values (FWS, 1991). The grassland habitats in the upper American River area vary in terms of their value for wildlife depending on the location (elevation) and size of the area.

The riverine areas along the upper American River support a high diversity of habitats (FWS, 1991).

Field sampling was performed in conjunction with the HEP evaluation, and a relative rating of the value of the various cover types was made based on representative species typically occupying various feeding and/or breeding guilds within those cover types (Corps, 1991; FWS, 1990).

Studies by FWS in 1989 in or near the project site in the American River canyon reported densities between 29 and 175 trees/acre (mean = 112/acre) and 194 shrubs/acre (113-279) for blue oak-foothill pine woodlands; between 96 and 167 trees/acre (mean = 133) for black oak woodlands; and between 33 and 179 trees/acre (mean = 112) for conifer forests

In an analysis of 635 Vegetation-Type Map data plots established by Weislander in the 1930's, Griffin (1988) reported oak woodland densities of 73 trees/acre near Jackson, 89 trees/acre near Chico, and 60 trees/acre near Redding. Based on an analysis of six oak-dominated map plots within the American River canyon provided by Dr. B. Allen-Diaz at the University of California at Berkeley, tree densities were calculated at between 50 and 130 trees/acre. On conifer-dominated habitats, densities in seven plots ranged from 35 to 85 trees/acre. An analysis of oak-dominated woodlands in Sequoia National Park by Vankat and Major (1979) reported densities of 283 trees/acre for blue oak woodlands, 260 trees/acre for lowland interior live oak woodlands, and 240 trees/acre for black oak woodlands. In an analysis of oak woodlands within Marble Valley in El Dorado County, densities of 17 trees/acre in blue oak savannas and 162 trees/acre in interior live oak woodlands were reported (McClelland Consultants, 1990). An analysis of oak woodlands at the proposed Cinnabar development near Shingle Springs in El Dorado County showed densities of 138 trees/acre in closed-canopy interior live oak forests, 80 trees/acre in open-canopy blue oak/interior live oak woodlands, and 8 trees/acre in blue oak/interior live oak savannas (Fugro West, 1995).

The characteristics of oak woodlands were based on the data summarized by Allen et al. (1989, 1991) for a variety of interior live oak-dominated woodlands in the Sierra Nevada foothills. The oak woodlands were separated into categories of overstory and understory canopy, and the cover of each group was adjusted based on the relative percent cover of species. For the chaparral category, specific information regarding average percent cover of the various species was not available, so the community composition was arbitrarily divided equally between the four principal species.

Upper American River

Significance Criteria

For purposes of this analysis, impacts were considered significant if operation of the project would substantially interfere with the movement of any resident or migratory wildlife species, substantially diminish habitat for wildlife, or involve the disposal of material which could pose a hazard to wildlife or plant populations.

Methodology.

Inundation Damages. To estimate the loss of vegetation resulting from operation of the dry dam, it was first necessary to determine the flood tolerance of the principal species inhabiting the cover types affected by inundation. This element focused primarily on three cover types: oak woodlands, chaparral, and conifer forest. There are no significant operational impacts to grassland and riparian communities; therefore, these cover types were not reanalyzed.

Several means were used to estimate the impact of periodic short-term flooding on the vegetation within the inundation zone of the proposed dry dam. The inundation study prepared for the previous EIS was reviewed. This study compiled scientific literature pertaining to the physiological effects of flooding on plants and the influence of the growing season on flood tolerance. The report summarized the limited information available in the literature pertaining to the flood tolerance of dominant plants in the American River canyon. The study also described the effects of limited flooding on similar plant communities along the Sacramento River near Redding, the lower American River, and along the inundation zones of reservoirs in the San Gabriel Mountains in Southern California. Based on these data, the report estimated direct and indirect losses of vegetation from construction and operation of the proposed dry dam. Since completion of that report, the design of the dry dam has been revised to minimize potential impacts of canyon sloughing by reducing the vertical drawdown rate of the flood pool. This has resulted in increased duration of flooding and higher elevations within the inundation zone than were reflected in the previous section.

Since the completion of the 1991 EIS, two additional studies have been conducted to estimate the flood tolerance of typical woody plants in the American River canyon. The first study (*Short and Long-term Impacts of Periodic Flooding on Chaparral and Oak Woodland Species Along the Upper Sacramento River, Shasta County, California*, 1995, Meredith, et al.) involved the analysis of impacts to a variety of oak woodland and chaparral tree and shrub species resulting from flooding along the Sacramento River below Keswick Dam. This study is included in appendix H. A study plot that was flooded during 1993 was examined to determine the survival of a variety of plants. In addition, the growth and condition of a group of whiteleaf manzanita plants flooded in 1993 were compared to a series of nonflooded plants. The study also examined the long-term impact of flooding on the oak woodland and chaparral plants. The second study (*Tolerance of Plants to Deepwater Flooding*, Hart et al., 1995) analyzed the response of a variety of immature oak woodland and chaparral plants to a series of submergence trials in Folsom Reservoir. This study is included in appendix H. Treatment depths were 37.5 feet, 100 feet, and 175 feet, and submergence durations were 7 and 13 days. The survival/mortality rates were observed immediately after the submergence tests and monitored for approximately 10 months through an entire growing season to track changes in growth and condition.

In both studies, the species were selected to represent dominant species in the American River canyon. Although these studies provide insight into the general inundation tolerance of the species, there remain uncertainties that cannot be completely addressed due to logistical constraints. For example, the Keswick study examined an array of plant sizes from seedlings to mature individuals; however, the flooding was shallow. The Folsom Lake submergence study involved deep flooding (to 175 feet), but included only young potted plants. Consequently, a data gap exists for the deep flooding of large, mature plants.

The submergence test substantiated that there are clear differences in the flood tolerance of specific species of plants. For example, manzanita suffered no losses, whereas chamise and toyon suffered almost 100 percent mortalities. Depth did not appear to exert a major influence on survival; however, duration was a critical factor. For example, foothill pine incurred moderate losses (8 to 25 percent) after 7 days of inundation regardless of depth, but high mortalities (67 to 92 percent) after 13 days of inundation. This study examined only young plants, which are generally believed to be much more vulnerable to flooding than more mature plants. Also, the overall condition of the individual species was variable. The chamise plants were first-year sprouts and were generally less than 1 foot in length. The study also revealed an apparent lag in mortality in some species. Immediately after the submergence trials in February 1994, the foothill pine group suffered only one mortality. By July, mortality increased to 6; by October, 33 specimens had died. Because no control plants died, mortality was attributed to the flooding. Immediately after the submergence test, seven toyon survived, but all died by the end of the study. However, in this case 50 percent of the controls also died, which suggests the plants may have been stressed prior to the experiment. Coffeeberry initially did not experience any mortality;

however, by October, 10 plants had died. Chamise suffered a high initial loss, but the survivors remained alive throughout the growing season.

The Keswick study supported many of the findings of the submergence study. First, whiteleaf manzanita experience approximately 20 percent mortality, but in each species, those individuals that died were generally immature. In fact, the mortality of interior live oak was almost exclusively confined to a cluster of small seedlings under a foothill pine tree. Because many other young plants did survive in other areas suggests that confounding factors may be contributory. Other species, such as wedgeleaf ceanothus, western redbud, coffeeberry, and mountain-mahogany, did not suffer any mortalities; however, the sample sizes were very small (two to six specimens), and no statistically significant inference was drawn. Second, the loss estimation analysis determined the approximate composition, density, and coverage of various species within the oak-woodland, mixed conifer woodland, and chaparral communities.

Impacts

The detention dam, by design, would detain water only in connection with high flows in the North and Middle Forks of the river. Inundation would be longest immediately behind the dam and would be significantly shorter as the inundation extends up the canyon. The prediction of future storms and flood frequency is a complex process and often uncertain. Historical flow frequency and magnitude of storms and hypothetical and artificial storms based upon computed and measured data are integrated to estimate future conditions.

In addition to the two studies described above, a third analysis was completed by FWS for its CAR to determine impacts to vegetation due to inundation. However, a detailed evaluation of the available data does not support precise estimates of inundation effects on vegetation in the American River canyon.

Both analyses based the estimated loss of vegetation attributable to periodic inundation on (1) reported physiological impacts (lack of oxygen, chemical changes in the soil), (2) physical impacts (toppling, landslides, erosion), (3) published inundation tolerance data on number of species occupying the various vegetation communities, (4) the frequency and duration of expected inundation during the period of analysis, (5) seasonality of flooding (dormant season versus growing season flooding), (6) age and vigor of individual plants, and (7) field examinations of sites with similar vegetative cover that have been periodically flooded in the past.

Flooding, however, is not likely during the growing season for most of the vegetation in the canyon. During winter, most plants are dormant or undergoing reduced physiological activity and are less prone to flooding impacts than plants actively growing. However, certain chaparral species actively grow during the winter, although at reduced levels, and

may be affected. Based on hydrologic projections, flooding is not likely to exceed 20 days, which is well within the growing season tolerance ranges for all but the most intolerant species.

The main differences in the two impact analyses stem from the methodologies used to predict slope stability losses and assumptions regarding the effects of periodic inundation on riparian/wetland habitats. The Corps/State analysis considered slope stability losses based on an evaluation of the effects of temporary inundation on the soils in the inundation zone. (See Geotechnical appendix M of the 1991 DSEIS/SDEIR.) FWS analyzed slope stability based on information from the cofferdam break and aerial photos. Since completion of the DSEIS/SDEIR, the design of the dry dam has been revised to minimize potential impacts of canyon sloughing by using operational gates to reduce the drawdown rate of the flood pool. This has resulted in longer detention periods and higher floodwater elevations within the inundation zone.

Loss Estimation. The mortality estimates were applied to the vegetative cover data to estimate the percentage loss by cover type for 7-day and 15-day flood events. Because no data existed for many of the species commonly found in the oak woodland, the following assumptions were made:

1) The tolerance of interior live oak was applied to all oak species because interior live oak is found in more xeric sites than canyon live oak and because the remaining oak species are deciduous and would be dormant during the flood season.

2) For the understory, if specific mortality data did not exist, a 100 percent loss was assumed.

3) For the conifer forest category, data from foothill pine were used as a proxy for the community. For the chaparral category, specific information regarding average percent cover of the various species was lacking, so the coverage was equally divided between the four principal species and applied the mortality factors.

4) Based on the inundation studies, percent mortality factors resulting from flooding between 0 and 7 days for oak woodland, mixed conifer woodland, and chaparral cover types were estimated to be 26, 15, and 48 percent, respectively, of the gross areal coverage of each community. The riparian communities were assumed to suffer no loss for this duration. For flood durations between 7 and 15 days, the percent mortality factors were 36, 75, and 69 percent for oak woodland, mixed conifer woodland, and chaparral, and the riparian

community was assumed to incur a 5 percent loss. No data existed for flood durations in excess of 15 days; however, a 50 percent loss of oak woodlands, a 100 percent loss of mixed conifer woodland and chaparral, and a 10 percent loss of riparian communities was assumed. Because the mortality estimates were derived from studies of immature plants which have generally been found to be the most intolerant life stage, the mortality factors were applied to 20 percent of the areal coverage of each cover type to estimate the losses of the most vulnerable life stages (for instance, seedlings and senescent/infirmed individuals).

5) For the less vulnerable mid-age life stages, estimated to total approximately 80 percent of the coverage of each community, reduced mortality factors were assumed. For durations less than 7 days, 7 to 15 days, and greater than 15 days in oak woodlands, mortality factors were 10, 15, and 25 percent, respectively. For chaparral and conifer forest, the corresponding mortality factors were 10, 15, and 50 percent, and for mid-aged riparian stands, the mortality factors were the same as for the immature individuals.

The mortality factors were then applied to the total acreage within elevation bands represented by the 0-7, 7-15, and >15-day flood durations from the Elevation-Frequency-Duration curve for the 10-, 50-, 100-, 200-, and 400-year flood events. The elevation bands from the GIS did not correspond precisely to the estimated flood elevations from the Elevation-Frequency-Duration curve because the base map contours were at 50-foot intervals. It was, therefore, necessary to interpolate between elevation bands. Based on these assumptions and estimates, a total of approximately 32 acres of vegetation would be lost during a 10-year event, 292 acres during a 50-year event, 361 acres during a 100-year event, 454 acres during a 200-year event, and 935 acres during a 400-year event.

On the basis of the estimated acreage loss by recurrence flood, a curve of acreage loss by exceedence frequency was constructed for each cover type. Integrating the area under each curve provided an average annual equivalent loss for each cover type for the 100-year period of analysis. For oak woodland, an average loss of 21.8 acres/year was estimated; for chaparral, 2.1 acres/year; for conifer woodland, 1.2 acres/year; and for riparian habitats, 1.8 acres/year. A total average annual loss of 26.9 acres was estimated for the period of analysis.

Landslide Damages. Some deep-seated older landslides in the flood pool area could potentially mobilize to some degree following a fill-and-drain cycle. The U.S. Fish and Wildlife Service in the previous Coordination Act Report reported that this was a significant potential adverse impact associated with the proposed detention dam. To address

this concern, staff with the Department of Water Resources, Central District, conducted a reconnaissance-level review of soils maps and aerial photographs to estimate the numbers and areal extent of the landslides, evaluate the potential for future movement, and develop management concepts for prevention and/or mitigation of significant additional landsliding. The results of that study are summarized in the following section.

That analysis showed at least 26 landslides in the proposed 400-year inundation pool area. Most of these landslides are along the southern canyon wall of the Middle Fork of the American River from its confluence with the North Fork to about Poverty Bar at river mile 57. A few landslides are also along the southern canyon wall of the North Fork of the American River, from the confluence to about North Fork Dam at river mile 52.5. Four large landslides were also noted between the proposed damsite and the confluence of the Middle and North Forks, three on the southern canyon wall and one on the northern canyon wall. The landslides along the North Fork are typically smaller than those along the Middle Fork. The combined areal extent of landslides in the 400-year inundation pool is about 15 percent of the total area.

An additional analysis of the area conducted by NRCS found that the most unstable areas are around road and trail cuts through deep soil deposits. This study also noted that these areas are inherently unstable and would be subject to sloughing during heavy rainfall with or without the detention dam.

Movement for most landslides in the reservoir area is generally initiated at their base by means of a small rotational slump. The movement forms a foot-berm in the bottom of the canyon that provides lateral support, which temporarily stabilizes the slump. The slump also forms a scarp part way up the canyon wall. The formation of the scarp removes lateral support for material farther up the slope, initiating another rotational or translational dislocation farther up the hill when conditions are conducive for movement, such as during periods of prolonged heavy rain. This process progresses up the canyon slope until the entire slide mass has moved downslope. The slide mass remains stable until floodflows erode the foot-berm to the point where the lower slump again becomes unstable, at which time the entire process repeats itself.

Landslide Impacts from the 1986 Cofferdam Failure. Following the failure of the cofferdam, several of the landslides along the North Fork of the American River were analyzed. Typically, the landslide masses are heavily vegetated and support many large mature trees. Several new head scarps were noted in the landslides below the high-water mark. The head scarps were all less than 20 feet high and completely devoid of vegetation.

Many of the older trees on the landslides had curved trunks, indicating that the trees have tried to right themselves following previous rotational movements of the slide mass. These trees are a clear indicator that the landslides had occurred at least once prior to the 1986 cofferdam failure. It is difficult to conclude to what degree the 1986 inundation was responsible for aggravating landslide movements. However, the prolonged heavy rains that caused the cofferdam to overflow and wash out in 1986 are probably the same conditions that historically initiated movement of the landslides.

Additionally, the Corps/State assumed that montane riverine and grassland vegetation types would not experience significant mortality from periodic inundation. Riparian vegetation is adapted both physiologically and physically to very prolonged flooding, and any grassland vegetation adversely affected by flooding is assumed to recover within the next growing season due to the annual growth strategies of the predominant species in the area (McClelland, 1991). Rocky and ruderal habitats would also be unaffected. The FWS included riparian vegetation along with the other cover types in its assessment of habitat loss due to inundation. FWS estimated total impacts to vegetation resulting from inundation and sloughing to be 2,073 acres.

The results of the two impact analyses represent a range of possible adverse effects associated with periodic inundation of the flood detention dam. Under both approaches, periodic inundation would temporarily diminish habitat suitability for species inhabiting the area. Loss of vegetation as a result of the periodic inundation over the 100-year period of analysis would be considered a significant adverse impact. Using the Corps/State evaluation, approximately 1,395 acres of habitat would be lost due to the physiological effects of periodic inundation. Table 9-2 shows the elevation, probability, and duration of inundation for the flood detention dam.

Inundation could cause wildlife to be lost by drowning, or wildlife could be adversely affected by increased predation while stranded, intraspecific aggression in foreign territory, relocation to less-than-optimal cover, or permanent displacement. In a review of pertinent literature, no specific studies could be found on the effects of a flood-control-only dam on wildlife species. The effects of flooding on wildlife would vary depending primarily on the ability of the affected species to escape to areas that are high and dry. This mobility would depend on the activity pattern of the species. Animals which are hibernating or otherwise in a reduced activity state will be less mobile. Similarly, animals which are breeding or have immobile young will be less able to stay ahead of the flood.

Large animals, most birds, and many small mammals and reptiles would escape the rising floodwaters and occupy adjacent habitats. However, based on the information derived from the literature, it is likely that losses of the smaller, less mobile species, such as reptiles, amphibians, and dormant or hibernating species, would be significant during periodic

TABLE 9-2

Elevation, Probability, and Duration of Inundation for the Flood Detention Dam at Auburn

	400-yr storm
Maximum elevation of inundation	942
Probability of occurrences of flood event: In any given year In the 100-year period of analysis	 0.25% 20%
Duration of inundation by elevation bands at the damsite	
490 - 530	>21 days
530 - 580	19 days
580 - 640	17 days
640 - 720	16 days
720 - 880	11 days
880 - 920	5 days
920 - 950	3 days
950 - 1000	1 day

1 Duration times reflect those for the average elevation of the band.
2 The maximum surface elevation for the 200-year event is 869 feet. Duration represents average duration of elevation 720-869. Duration at maximum water-surface elevation (869) is 1 day.
3 The maximum surface elevation for the 100-year event is 847 feet. Duration represents average duration of elevation 720-847. Duration at maximum water-surface elevation (847) is 1 day.

inundation. Because of similar adjacent habitats and the reproductive rates of the affected species, recovery would take place over relatively short periods. It is likely that net populations of the most vulnerable species would be lower than at present. Unless more tolerant species replace the net loss, secondary predators would also be affected by the reduction of prey base. These are considered significant adverse impacts. Some of the inundation areas would remain habitable for many species.

Loss Estimation by FWS. The mortality estimates were applied to the coverage data to estimate the percentage loss by cover type for 7-day and 15-day flood events. Because no data existed for many of the species commonly found in the oak woodland, the following assumptions were made. First, the tolerance of interior live oak was applied to all oak species because interior live oak is found in more xeric sites than canyon live oak, and because the remaining oak species are deciduous and would be dormant during the flood season. For the understory, if specific mortality data did not exist, a 100 percent loss was assumed. For the conifer forest category, data from foothill pine were used as a surrogate for the community. For the chaparral category, specific information regarding average percent cover of the various species was lacking, so the coverage was equally divided between the four principal species, and applied to the mortality factors. As a result, for the

7-day inundation event, gross loss estimates for the oak woodland were 26 percent; conifer forest, 15 percent; and chaparral, 48 percent; for the 15-day event, the estimates were 36, 75, and 69 percent.

The percent loss estimates were then applied to the total acreage that would be inundated during 100-year, 200-year and 400-year flood events based on the discrete elevation bands from the Elevation-Frequency-Duration curve. Based on these assumptions and estimates, approximately 807 acres would be lost for a 100-year event, approximately 1,000 acres during a 200-year event, and approximately 2,073 acres during a 400-year event. These estimates should be viewed as extreme maximums because impacts are largely based on effects on immature age classes, which are the most vulnerable life stage.

Mitigation Plan - The fundamental premise of the proposed mitigation strategy is that oak woodland, chaparral and conifer forest can be restored so that, over time, wildlife habitat values can be replaced to approximately the same values as presently exist in the American River canyon. While there would be a time lag between implementation of mitigation and the maturation of the habitat (+40 years) to predisturbance levels, actual losses are also expected to occur over time. In other words, it is highly improbable that a 400-year flood event (maximum vegetation loss) would occur until the replacement habitat has matured. In all likelihood, the mitigation would provide an incremental increase in habitat over the period of analysis.

Selection of sites for mitigating significant impacts to native vegetation types as a result of impacts from the operation of the flood detention dam are summarized below. Numerous factors must be considered when selecting sites for mitigation purposes. These factors include:

- restoring degraded sites within the project site;
- converting one habitat type to another (e.g., oak woodlands) with higher habitat values, onsite;
- preserving existing habitat in-kind in the watershed of the project site;
- enhancing/restoring degraded habitats offsite but in the region; and
- preserving high-quality habitats offsite in the region.

Each of these criteria has one or more components or variables that can be implemented to select appropriate and cost-effective mitigation sites. Because the primary objective of the mitigation is to replace habitat values lost as a result of operating the detention dam, mitigation opportunities to accomplish this objective should be the first

decision criterion used in selecting sites for mitigation purposes. Costs associated with each mitigation strategy should be used at the second level of site identification.

Site selection should consider the feasibility of restoration. That is, can the site sustain, over the long term, the target vegetation type? Sites that historically supported the target vegetation type should be given highest priority over areas with only potential to sustain the target vegetation type.

Strategy 1: Avoidance. The primary mitigation objective is to avoid impacts. The current dam configuration was designed to avoid or minimize the impacts to canyon vegetation resulting from canyon sloughing. This has been accomplished by reducing the flood pool drawdown rate through the inclusion of additional sluices.

Strategy 2: Restoring Degraded Habitats Onsite. Because onsite mitigation is preferred, opportunities available to replace lost habitat values onsite should be given priority over offsite strategies. This strategy involves two options: (1) adoption of an adaptive management plan for the purpose of identifying postflood vegetation losses and implementation of a vegetation restoration program on the actual sites damaged and (2) restore several small sites within the project area have been degraded or are managed in a manner that prevents full use of the habitat by native plants and wildlife. For example, off-highway vehicle activities at Mammoth Bar in the river canyon currently reduce the number of plants and wildlife that inhabit the site. Removing off-highway vehicles and restoring degraded habitats would provide improved habitat conditions. Based on analysis of aerial photographs of the project area and supplemented by field reconnaissance surveys, mitigation opportunities appear to be very limited within the inundation zone because the area is presently moderately to densely vegetated in the target cover types.

Strategy 3: Habitat Type Conversion. Habitat type conversion can achieve mitigation goals for the resulting habitat type but may cause additional impacts not associated with the original project. Although habitat type conversion in the river canyon would provide onsite mitigation, this strategy would cause impacts to other habitats that may be important as well.

Strategy 4: Preserving Existing Habitat In-kind in the Watershed of the Project Site. Many areas in the watershed are unprotected from habitat degradation; therefore, obtaining these areas and preserving them for existing habitat values would satisfy important habitat conservation needs. While this strategy ensures long-term preservation of the target habitat type, it does not provide no-net-loss acreage mitigation.

Strategy 5: Enhancing/Restoring Degraded Habitats Offsite in the Region. Many opportunities for habitat enhancement or restoration offsite have been identified. Private and public properties occur in adjacent watersheds that are degraded and have enhancement

potential. While public lands are already protected, to some extent, from habitat degradation, habitats on private property are almost entirely unprotected and could be lost in the near future from agricultural, timber, or urban development. Many lands in the Sierra Nevada foothills have been cleared of oak woodlands and scrub vegetation to improve range (for grazing), harvest wood, plant crops, or build houses. These areas have the highest potential for restoration and greatest need for protection. Because large land areas are more efficient to manage than small parcels, private property adjacent to public lands should be given higher priority for acquisition to use for mitigation than others private parcels. Potential sites have been identified along the South Fork of the American River and along adjacent watersheds in the Yuba River and Cosumnes River drainages.

Strategy 6: Preserving High-quality Habitats Offsite in the Region. Many areas in the Sierra Nevada foothills outside the watershed are unprotected from habitat degradation; therefore, obtaining these areas and preserving them for habitat values will also meet important habitat conservation needs. Although this strategy ensures long-term preservation of the target habitat type, it does not provide no-net-loss mitigation.

Adaptive Management Program (ADP). Adaptive management strategies are intended to use a project itself as a method to examine and/or refine ecological impact estimates that are not reliably predicted using conventional preproject study techniques. Adaptive management strategies are recommended by the National Academy of Science for addressing the issue of uncertainty in estimating ecological effects. The purpose of the ADP for the detention dam is two-fold. First, it would establish a monitoring program to research the effect of periodic flooding in the American River canyon. Because the detention dam would inundate low elevations more frequently, these areas would provide an opportunity to monitor flooding effects on vegetation and permit the measurement of the effectiveness, applicability, and utility of mitigation measures and revegetation techniques. Measures that appear to work best can then be adopted for the entire inundation area if they are required. Second, the ADP would provide the mechanism to revegetate sites damaged or destroyed by flooding and, over time, more quickly recover lost habitat values. The following discussion is intended as a general framework for the AMP. Further definition and refinement would be completed by the AMP team during PED phase.

Project Monitoring. The Adaptive Management Program will be reviewed by sponsoring and resource agencies to identify key variables and sites for monitoring, to test the underlying ecological principles involved in the assessment, and to determine appropriate monitoring techniques. The ADP team will identify the components of the plant communities and define degradation thresholds which would constitute a significant loss of esthetic and habitat value and warrant remedial action. The ADP team will also establish a method for distinguishing between normal perturbations in the vegetative communities from those induced by periodic flooding. The team will also establish a system for estimating and apportioning remediation costs. On an annual basis, the AMP team will review results of the current year's activities and scope any additional tasks required. In compliance with NEPA

and CEQA regulations, the monitoring review team will report and distribute the findings of the mitigation and impact monitoring studies. The AMP would be reviewed periodically and objectives refined as necessary. Reviews would be made at least every 3 years or more often if flood or other major events occur which significantly alter any plant communities in the project area.

Baseline Monitoring. The first phase of the monitoring program will be the collection of baseline data to determine existing/preinundation conditions. Low altitude, high resolution aerial photographs of the proposed inundation zone will be obtained to document baseline conditions. Prior to aerial photography, elevation monuments will be positioned at a number of locations to accurately determine ground elevations using standard photo analysis techniques. Using a Geographic Information System (GIS), the existing vegetative communities will be delineated and areal coverage quantified. The aerial photographs will be taken in mid-summer at full canopy development. Monitoring plots and transects of key vegetative communities will be established within the inundation zone. In addition, control plots representing the same vegetative communities will be established in areas outside the inundation zone.

Routine (nonflood) Monitoring. At 3- to 5-year intervals, new sets of aerial photographs of the canyon and monitor and control plots will be obtained. The flightlines, date, and time of the photographs will be the same as the baseline photographs. The routine aerial photographs will be compared against baseline photographs to determine any changes in the areal extent of vegetation and canopy closure resulting from natural and non-project effects. Surveys of the monitor and control plots will be conducted using the methods described for the baseline sampling in order to identify and document non-project-related changes to vegetative communities and wildlife.

Postflood Monitoring. In the summer following significant canyon inundation, new sets of aerial photographs will be obtained in mid-summer immediately following the flood season. Significant canyon inundation would be based on a minimum duration of 4 days with a minimum water-surface elevation of 650 feet msl. This roughly corresponds to approximately a 40-year recurrence flood. The mid-summer timing is to ensure that the floodflows have fully receded and protracted and residual vegetation impacts have had sufficient time to manifest. Ground surveys will be conducted to distinguish flood-induced impacts to vegetation and wildlife. These data will permit a comparison of preproject loss estimates with actual losses and permit new refined loss estimates based on real time site-specific data. Based on postflood observations and analyses, previously employed mitigation measures will be monitored and evaluated to eliminate measures which are ineffective and incorporate new state-of-the-art measures for experimental purposes. Postflood monitoring will also facilitate the tracking of potentially cumulative impacts. Significant flood events would trigger a new cycle of monitoring and analysis.

<u>Revegetation Program</u>. The second function of the AMP is to develop and implement the revegetation program within the canyon to rehabilitate areas damaged by flooding.

Mitigation

The adaptive management plan approach would involve replacing habitat after it is lost during a detention period. Implementing the adaptive management plan would require that the area behind the detention dam be surveyed after each detention episode to determine the damage to the vegetative community in the canyon. When a vegetative loss is identified, the extent would be delineated and the type of vegetation determined. An equivalent amount and type of vegetation would be planted at the site(s). The benefits of this mitigation strategy are that the mitigation would be accomplished at the location of the loss, and there would be no land acquisition costs. A significant concern about this approach over an offsite alternative is the possibility that revegetation efforts conducted after a flood may be lost or damaged by succeeding floods.

To implement an Adaptive Management Plan as mitigation, 1,481 acres of land bordering the North and Middle Fork channels would be used to replace vegetation lost over the project life. The methods to be used are described above.

To complete the mitigation required for project impacts, an additional 2,962 acres of canyonlands would be purchased adjacent to the Yuba River near Englebright Lake. These lands would be planted with appropriate native species.

ENDANGERED SPECIES

No-Action Condition

The host plant of the valley elderberry longhorn beetle, the elderberry shrub, is known to be present in the upper American River canyon, primarily along the North and Middle Forks of the American River. A survey in the area that would be inundated by a detention dam identified 205 shrubs along the Middle Fork and 5 shrubs along the North Fork (Jones and Stokes, 1995).

Significance Criteria

For purposes of this analysis, the project will be considered to significantly affect the valley elderberry longhorn beetle if operation of the detention dam results in the partial or complete destruction of any elderberry shrubs in the project area.

Impacts

The information provided in the 1991 EIS was based on habitat mapping of the American River canyon. The previous analysis was based on cursory field surveys which concluded that five shrubs per acre would be lost throughout the inundation zone. More recent detailed field surveys indicate the actual number of elderberry shrubs that could be lost during the 100-year period of analysis is 103 of the 210 total found in the canyon. Locations of the shrubs are shown in the Endangered Species appendix Biological Data Report and Preliminary Section 7 Biological Assessment on the Valley Elderberry Longhorn Beetle, figure 4 (Montgomery Watson, 1995).

According to the Biological Data Report and Preliminary Biological Assessment on the valley elderberry longhorn beetle (appendix K) completed by Montgomery Watson, the lower bound of the mortality regression was based on data from the Pacific Northwest for blue elderberry. According to Walters et al. (1980), blue elderberry can withstand flooding for 1 to 3 months during the growing season. Because the longest duration predicted for the area above the dry dam is 21 days, it was assumed, based on these data, that limited mortality would result from inundation. This assumption is consistent with the interpretation that blue elderberry's inundation response is similar to that of willow and other low-terrace riparian trees and shrubs.

Operation of the detention dam could adversely affect the shrub and beetle by temporarily inundating portions of the North and Middle Fork canyons where the species resides. The maximum inundation period is expected to be 21 days; it is possible that as many as 103 shrubs could be lost over the period of analyses.

Mitigation

Elderberry shrubs lost as a result of project operation would be replanted in-kind and onsite at a 3:1 replacement ratio in suitable areas along the upper American River in the adaptive management area. Because survey results show that most shrubs are found on the Middle Fork, a one-time replanting would be done here to guarantee the highest chance of survival and to replace all shrubs expected to be lost over the project life.

CULTURAL RESOURCES

Baseline

The 894,000-acre-foot potential detention zone contains 17 prehistoric and 163 historic sites (table 9-3). Most of the 17 prehistoric sites consist of bedrock mortars, although a rock shelter, lithic scatter, and housepit could also be affected. Among the

163 historic sites are settlements, mining complexes (with evidence of machinery and structures), mined areas (mainly tailings, trenches, pits, and shafts), areas of structural development, bridges, check dams, ditch remnants, and miscellaneous areas such as roads, trails, and trash dumps. The mined areas are believed to be among the least likely to suffer major impacts (McCarthy, 1989).

TABLE 9-3

Archeological Site Impact Summary
Detention Dam Plan

Site Type	Below Confluence	North Fork	Middle Fork	Total
Historic	10	79	74	163
Prehistoric	2	8	7	17
Total	12	87	81	180

Significance Criteria

For the purposes of this analysis, impacts to cultural resources are considered significant if the affected property is a site, building, structure, or object which is recognized as culturally or historically significant based on the institutional, public, or technical criteria described in chapter 6 under Cultural Resources for the No-Action Alternative.

Impacts

Operation of the detention dam would not significantly affect data recovery to document the sites within the inundation zone because there would be no permanent impoundment of water behind the dam. However, periodic, temporary inundation of the canyon area could cause substantial site disturbance. Impacts from temporary inundation can include, but are not limited to, physical destruction by waves at varying elevations, bank slumping, and development of a new zone of frequent wet-dry cycling which enhances deterioration of some materials. The architectural and historic integrity of the North Fork Dam and the Mountain Quarries/No Hands bridge could be affected by periodic inundation, as could the historic Western States Trail.

The Highway 49 replacement alignment would be near five archeological sites and the historic Mountain Quarries/No Hands bridge. It is possible that the new high bridge and the highway replacement could be constructed without any direct impacts to historic, prehistoric, or submerged resources by designing the alignment to avoid these. Impacts from visual intrusion to the Mountain Quarries/No Hands bridge would be unavoidable. The Ponderosa Way bridge is more than 50 years old, and it will be evaluated to determine eligibility for National Register listing.

Two unavoidable significant impacts would also occur which cannot be fully mitigated. There is a high potential for the loss of a number of historic sites during periodic inundation of the area behind the flood detention dam. Sloughing, primarily at trails and road cuts, due to soil instability would cause total or partial site destruction, including loss of integrity of location and displacement of stratigraphic context. The respect humans attribute to cherished places of their physical surroundings such as historic sites, open space, and the natural environment is considered to be almost universal (Hiss, 1990). Construction of a dam would intrude upon the quality of the historical setting and would detract from the public's visual and esthetics experience; however, the dam would not be visible from most areas.

Mitigation

No additional cultural resource surveys in the canyon area would be initiated by the Corps until after authorization of this plan. Impacts from temporary inundation, including sloughing, wave action, and a new zone of wet-dry cycling, could be reduced by data recovery, documentation, and structural protection, but not to a less than significant level. Visual impacts of the dam and Highway 49 replacement could be significant and unavoidable.

TRANSPORTATION

Operation of the Detention Dam Plan would have no impacts on regional transportation because a relocation of Highway 49 is included as a project feature.

HAZARDOUS AND TOXIC WASTE

No-Action Condition

The upper American River canyon was historically mined extensively for gold. At the present time, there are few remaining small operations, and none are regulated by the Central Valley Regional Water Quality Control Board. In the past, the bigger mines used

hydraulic methods to mine the gold. Hydraulic mining has been banned for decades because it was the source of significant sedimentation downstream. A review of the Regional Water Quality Control Board's Listing of Dischargers and conversation with board staff revealed no problem active mine, abandoned mine, or tailings within the project area. No acid mine drainage problem had been documented in the past. (Dan Fua, Department of Water Resources, personal communication, November 14, 1991.)

A review of the geology of the project area revealed no significant deposit of acid-forming rocks such as pyrite in the upper American River. These deposits have been known to occur in the lower elevation of the Sierra foothills. The small pyrite deposits that may have been exposed by hydraulic mining in the upper American River have since been mineralized, such as at the Sliger Mine in the Middle Fork American River, and prevented from producing acid drainage.

<u>Significance Criteria</u>

For purposes of this analysis, any action which substantially increases the risk of an uncontrolled release of hazardous or toxic materials into the environment is considered a significant impact.

<u>Impacts</u>

Hg levels are currently being evaluated in the Upper American River canyon as well as in other parts of the Sierra. Studies using bioindicators (trout and juvenile insects) have shown that the Middle and North Forks of the American River contain the lowest levels of mercury of all other studied Sierran streams or rivers (Slotton, pers comm, 1996).

Temporary inundation of the canyon would not cause the release of methyl mercury. Methyl mercury formation requires anaerobic conditions for more than several weeks. The flood pool would not be inundated long enough to allow methyl mercury formation.

There are no known operations, past or present, that used cyanide to extract gold in the upper American River. (Dan Fua, Department of Water Resources, personal communication, November 14, 1991.) Since there would be no excavation of gravel bars and deposits in the project area, except for keying the dam foundation, there is no likelihood that any acid-forming rocks would be reexposed during the construction and operation of the project. (Dan Fua, Department of water Resources, November 14, 1991.)

VISUAL RESOURCES

No-Action Condition

Visual resource values in the upper American River canyon area are high. Visual resource values in areas where construction work associated with dam construction, replacement of Highway 49, and the strengthening of Ponderosa Way bridge is proposed are low due to construction disturbance from Reclamation's multipurpose dam.

Significance Criteria

For a project to have a significant adverse effect, the project or features of a project would change the visual quality of sensitive viewing components within the observable scene. A large number of viewers would notice a significant change to the character of the existing setting. Such changes may include a project feature significantly blocking a desirable viewing component or replacement of valuable environmental resources previously regarded as visual.

Impacts

<u>Lower American River, Folsom Reservoir, Downstream From American River</u>. There would not be any adverse effects to visual resources in these areas.

<u>Upper American River</u>. Adverse effects to visual resources behind the dam would be limited to those caused by extremely high precipitation and runoff events. The maximum elevation behind the dam during a 400-year storm would be 942 feet. Much of this area would be submerged. As impounded floodwater recedes, some sediment and floating debris would be deposited upstream from the dam, becoming lodged behind trees, rock outcrops, and other obstacles. Over time, much of this debris would decompose and become covered by vegetation, steadily decreasing its visual prominence. No landslides are expected because the drawdown rate would be controlled through gates on the dam. Although the canyon is not visible to a large number of viewers, the canyon is considered by many to be a valuable environmental resource. This is considered to be a significant, mitigable adverse effect to visual resources.

Mitigation

The Adaptive Management Plan would mitigate for lost vegetation in the canyon area. Replanting of vegetation, in addition to the natural revegetation, would offset the degraded visual quality of the canyon area.

CONSTRUCTION IMPACTS

LAND USE

No-Action Condition

The upper American River area encompasses portions of Placer and El Dorado Counties and includes the lands within and immediately around the damsite near Auburn ("canyon area") and the lands occupied by the surrounding communities. Most of the land in the canyon is owned by the Federal Government as part of the authorized multipurpose Auburn Dam project.

Significance Criteria

Land use impacts are considered significant if the project would cause a substantial long-term disruption of an existing or reasonably foreseeable future land use.

Impacts

The Detention Dam Plan would not affect land uses in the upper American River area due to construction, operation, and maintenance of the dam; relocation of Highway 49; and mitigation for the adverse effects of this activity. Land use patterns in the project area would not be affected by construction of the new bridge realignment and implementation of a fish and wildlife mitigation plan.

Mitigation. No mitigation is required.

RECREATION

No-Action Condition

Lower American River. Earthen levees 20 to 30 feet high border much of the lower half of the American River parkway, blocking out surrounding urban development and activity. These physical barriers and extensive stands of mature riparian forest give the parkway a "wilderness in the city" quality. The Jedediah Smith Trail provides bicycle, pedestrian, and equestrian trails from Discovery Park to Folsom Reservoir and is one of the parkway's most popular features. The trail also connects with the Sacramento River Trail and Old Sacramento Historic Park. The 23 miles of river below Nimbus Dam is included in both the State and Federal wild and scenic river systems.

<u>Folsom Reservoir</u>. Folsom Reservoir supports numerous water-based activities such as boating, waterskiing, and fishing. The shoreline provides sandy swimming beaches, both formal (with lifeguard services) and informal. Surrounding Folsom Reservoir is a landscape with important scenic, natural, and cultural values. Recreational facilities include camping and picnic areas, boat launch ramps, restrooms, concessions, bicycle and mountain bike trails, and equestrian trails and staging areas.

<u>Upper American River</u>. Reclamation contracted with the Department of Parks and Recreation to provide recreation and public-use management services on the lands within the boundaries of the multipurpose Auburn Dam project, known as the Auburn State Recreation Area. The recreation area includes 42,000 acres and 48 miles of the North and Middle Forks of the American River extending from the damsite to the Iowa Hill bridge on the North Fork and Oxbow Reservoir on the South Fork. The reach of river just upstream of the dam site is currently closed to recreation use.

Its nearness to major population centers and diverse recreation base make the Auburn State Recreation Area one of the most used and significant recreation resources in northern California. Bicycling has increased dramatically in the area. There is continuing demand for equestrian trails and other trails. Approximately 72 miles of hiking trails, 66 miles of equestrian trails, and 15 miles of fire road are open to mountain bikes in the recreation area and provide year-round recreation opportunities.

The trails and roads include Manzanita Trail, Middle Road Trail, Pointed Rock Trail, Old Quarry Road Trail, Tinkers Cuttoff, Old Stage Road, Old Auburn-Foresthill Road, a number of other trails, and many mountain bike trails. Additionally, the Western States Trail has been included as the trans-Sierra route of the proposed coast-to-coast American Discovery National Trail.

The Department of Parks and Recreation has the responsibility for maintaining these trails; due to budget constraints, the only maintenance is accomplished is by volunteer workers, usually associated with the Western States Endurance Run.

<u>Downstream from American River</u>. Levees and stability berms along landward slopes of the east of the Sacramento River in Natomas would be strengthened and raised.

<u>Significance Criteria</u>

Impacts to recreational resources are considered significant if the project would cause a substantial long-term disruption of an existing recreational activity which is recognized institutionally in the plans and policies of public agencies or private organizations, or which is identifiable based on the general popularity of the activity.

Impacts

Lower American River. During construction of the seepage cutoff wall, users of the portion of the American River bike trail that extends along the roadway atop the levee would experience a short-term disruption.

Folsom Reservoir. Returning Folsom Reservoir flood control operation to a fixed storage space of 400,000 acre-feet would have a minor benefit to recreation at Folsom by reducing the drawdown during winter, assuring higher lake levels in the summer.

Upper American River. Construction of the dam would have unavoidable short-term impacts on existing recreational uses in the area between the confluence of the North and Middle Forks and the damsite. The completed structure would permanently obstruct movement between points along the North Fork of the American River above and below the damsite.

Downstream from American River. The levee work along the Sacramento River would not interfere with recreation associated with the Sacramento River, as the work would be done exclusively along the landward levee slope. No impacts to recreation are expected as a result of this work.

Mitigation

Lower American River. Mitigation for recreation impacts would include the installation of guide signs to route recreation traffic around areas of damage and reconstruction.

Upper American River. There would be no mitigation required because the dam construction would not affect recreation uses in the area.

FISHERIES

No-Action Condition

Fish species that are year-round residents of the North Fork include smallmouth bass, bullhead, sunfish, riffle sculpin, Sacramento sucker, and Sacramento squawfish. Historical records of the Middle Fork fishery are limited. Rainbow and brown trout are stocked yearly. Resident fish species of the Middle Fork include Sacramento hitch, Sacramento sucker, Sacramento squawfish, riffle sculpin, brown trout, and rainbow trout. Fishery No-Action Conditions of the lower American River and Folsom Reservoir are discussed under the Folsom Modification Plan.

Significance Criteria

For purposes of this evaluation, fisheries impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory fish, substantially diminish habitat for fish, or involve discharges of material which pose a hazard to fish.

Impacts

Lower American River. The construction of 24 miles of seepage cutoff walls would not affect the fisheries, since the work would be done away from the river or any other water source. Based on the limited scope of the work and the temporary construction effort, impacts from seepage construction would not be significant to fish.

Upper American River. There would be no impacts to fisheries in the upper American River. However, if best construction management practices are not adhered to, fishery resources could be adversely affected by the increased turbidity resulting from construction associated with strengthening the Ponderosa Way bridge. Dam and access road construction and relocation of Highway 49 would not adversely affect fishery resources in the area.

Mitigation

Any adverse impacts to fishery resources would be mitigated by implementing the water-quality requirement for construction activities.

VEGETATION AND WILDLIFE

No-Action Condition

Habitat at the proposed damsite includes seven specific cover types: south-slope oak woodland, north-slope oak forest, chaparral, nonnative (naturalized) annual grasslands, conifer forest, montane riverine, and rocky/ruderal. Conditions for the lower American River area and the area downstream from the American River are presented in chapters 7 and 8 under the sections discussing construction impacts to vegetation and wildlife.

Significance Criteria

For purposes of this analysis, impacts were considered significant if construction of the project would substantially interfere with the movement of any resident or migratory

wildlife species, substantially diminish habitat for wildlife plants, or involve the disposal of material which could pose a hazard to wildlife or plant populations.

Impacts

Lower American River. The construction of 24 miles of seepage cutoff walls would cause minimal adverse effects to scattered grass areas along the fringes of the levee crown. The operation of construction equipment could cause a short-term disturbance to wildlife. Based on the limited scope of the work and the temporary construction, impacts from seepage wall construction to vegetation or wildlife would not be significant.

Upper American River. A total of 313 acres of vegetation would be affected in the upper American River area as a result of dam and access road construction and the replacement of Highway 49. Approximately 73 acres of oak woodland, 39 acres of riparian habitat, and 201 acres of nonnative grasslands would be removed to complete construction at the damsite, which includes clearing the damsite footprint, excavating for dam foundation and abutments, and pouring concrete for the foundation and dam construction. The excess material from excavation would be placed in two areas—the existing foundation keyways and the Salt Creek boat ramp area. No impacts to vegetation are expected from this disposal, as the margins of the boat ramp are sparsely vegetated in nonnative grasses and ruderal forbs. A thin stringer (less than one-fourth acre) of riparian shrub-scrub has invaded the cracks in the concrete along the west keyway. The loss of this minimal acreage of riparian shrub-scrub and nonnative grassland/ruderal land would not constitute a significant impact.

Construction of the flood-control dam would require approximately 6.8 million cubic yards of aggregate. Vegetation loss would be minimal because the aggregate would be taken either from cofferdam material or from an underground mine immediately downstream from the dam. The only loss of vegetation would be in the area excavated to form the mine entrance portals. The entrance portals to the mine would be approximately 300 feet wide and 40 feet high.

The replacement of Highway 49 would result in adverse effects due to clearing for staging areas, permanent roadway and bridge abutment areas, areas under the bridge which have less than 50 feet of clearance, construction access roads, and the construction of the piers. No borrow or disposal areas are required. Strengthening the Ponderosa Way bridge would not adversely affect vegetation or wildlife because all work would be confined to the existing bridge site.

Mitigation

The mitigation plan to compensate for vegetation and wildlife adversely affected by construction is incorporated into the mitigation plan presented earlier in this chapter.

ENDANGERED SPECIES

No-Action Condition

Construction of the features included in the Detention Dam Plan would potentially affect the State listed threatened Swainson's hawk and giant garter snake. The conditions in the project area which support these species have been previously described (see Endangered Species discussion in chapter 4 and under the No-Action Alternative in chapter 6.

Significance Criteria

For purposes of this evaluation, any action taken directly in connection with, or indirectly caused by, the project which would affect the continued existence of a threatened or endangered species is considered a significant adverse effect.

Lower American River and Downstream From American River

Active Swainson's hawk nests could be destroyed or disturbed during construction activities along the Sacramento River under the Detention Dam Plan. Loss of nests or disturbance to nests resulting in loss of eggs or death of young would adversely affect the Swainson's hawk.

Construction activity along levees in the Natomas area under the Detention Dam Plan could kill hibernating giant garter snakes.

Mitigation

To avoid effects to the Swainson's hawk, the Corps would implement seasonal restrictions on construction activity according to DFG guidelines for mitigating effects on the Swainson's hawk (DFG, 1994).

Seasonal restrictions on construction activities (October 1 through May 1) to potential habitat of the giant garter snake would be implemented according to California Department of Fish and Game guidelines (1992) to avoid affecting the giant garter snake. Construction within giant garter snake habitat would be restricted to nonhibernating periods.

WATER QUALITY

No-Action Condition

Lower American River. Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. These low flows periodically result in high water temperatures that may jeopardize juvenile fish. Runoff from the portions of the lower American River area north of the river is collected and discharged into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

Upper American River. Water-quality management by the CVRWQCB (Central Valley Regional Water Quality Control Board) includes establishment of beneficial uses and water-quality objectives. Protection and enhancement goals for identified beneficial uses determine the overall water-quality objectives. The beneficial uses of the American River include:

- Municipal and domestic supply
- Irrigation
- Stock watering
- Water contact recreation
- Canoeing and rafting
- Noncontact water recreation
- Hydroelectric power generation
- Warm freshwater habitat
- Cold freshwater habitat
- Spawning (warmwater)
- Spawning (coldwater)
- Migration
- Wildlife habitat
- Riparian habitat

The primary beneficial uses in the vicinity of the project area include domestic water supply, contact and noncontact recreation, coldwater spawning, cold freshwater habitat, and wildlife habitat.

Significance Criteria

For the purposes of this analysis, any degradation of water quality below standards established by SWRCB, CVRWQCB, or EPA would constitute a significant impact.

Impacts

During construction of the detention dam, material would be removed from the riverbed to reach bedrock. Suitable material would be crushed and mixed into the concrete and used to construct the dam structure. The unsuitable material would be placed in disposal areas in the old keyway or near the Salt Creek boat ramp. This work would be accomplished during the summer low-flow period, and the river would continue to flow through the existing diversion tunnel.

The aggregate would be extracted from a new quarry proposed 100 feet above the river and immediately downstream from the damsite on the left bank. The quarry would be excavated into the canyon wall as a cave. Material would be delivered to the mixing plant, which would be located in the riverbed 100 feet downstream from the damsite.

Construction of the proposed Highway 49 relocation would affect approximately 27 acres of upland habitat which could be subject to erosive forces if not properly protected by reseeding or other appropriate method. This work would also be accomplished during the summer when there is little or no rainfall.

Mitigation

Direct impacts from sedimentation and incidental spillage would be minimized by temporarily diverting natural streamflows from the active construction sites. This would make construction easier in the dewatered channel and would minimize contact of potentially harmful materials with the river. The Auburn Dam site has a diversion tunnel in place from Reclamation's previous construction at river mile 47.2. Installing a network of temporary interceptor dikes and ditches at construction sites would convey sediment-laden flows into temporary settling basins. These basins would retain the waters and allow sediments to settle. Finally, certain construction activities would be limited to annual low-flow periods. The release waters from the construction site are regulated by RWQCB. Selected water-quality parameters (Ph, dissolved oxygen, and turbidity) should be regularly monitored during construction.

No mitigation would be necessary because, typically, construction requires the use of containment barriers, fences, or dikes described above. All work would be accomplished during low-flow periods and generally well away from flowing water. No mitigation is required because there would be no significant degradation of water quality parameters in the area resulting from construction activities.

CULTURAL RESOURCES

No-Action Condition

The damsite has been extensively modified by construction activities associated with Reclamation's multipurpose dam. The No-Action Conditions for the lower American River and the area downstream from American River are the same as the No-Action Conditions for the Folsom Modification Plan.

Significance Criteria

The significance criteria for all project areas potentially affected by the Detention Dam Plan is discussed in chapter 6, the No-Action Alternative.

Impacts

Lower American River. The cultural resources inventory of the lower American River Area of Potential Effect focused only on direct impact areas relating to construction of seepage cutoff walls along a 24-mile-long corridor of the American River from Nimbus Dam to its confluence with the Sacramento River. Construction of the seepage is not expected to significantly affect cultural resources along the lower American River.

Upper American River. The flood detention dam would be built near the site of Reclamation's authorized multipurpose dam. Because the damsite has already been extensively modified by construction, no further impacts to cultural resources are expected. However, significant sites could be disturbed as a result of construction in project areas away from the damsite.

Downstream from American River. Proposed levee strengthening and raising activities along the landside berm of the Garden Highway (River Levee) bordering the Sacramento River between river miles 66.8 to 78.9 has the potential to affect a number of prehistoric and historic sites. Further analysis of project impacts is required before a more accurate assessment can be made.

Mitigation

A cultural resources PA (Programmatic Agreement) has been developed and adopted between the Corps, the Office of Historic Preservation, and the Advisory Council on Historic Preservation regarding implementation of the ARWI project. Other signatories of the PA include the Bureau or Reclamation, Mid-Pacific Region; The Reclamation Board of the State of California; and Sacramento Area Flood Control Agency. This PA will be used to complete Section 106 responsibilities for the wide range of related Federal actions expected to be carried out in connection with the ARWI projects. The PA includes procedures for treatment of indirect and direct impacts of the levee improvements associated with the detention dam. The executed PA specifies inventory (Stipulation 2) and National Register evaluation procedures (Stipulation 3) for historic properties, as well as the process for development of Historic Properties Treatment Plans (Stipulation 4). Additionally, report format and review (Stipulation 5), participation of interested persons (Stipulation 6), curation of recovered data (Stipulation 7), and professional qualifications (Stipulation 8) are also detailed.

As specified in the Corps' 1992 FEIS/EIR for the ARWI project, mitigation measures may include archeological documentation, architectural and engineering documentation, and historical documentation, following standards and guidelines adopted by the Secretary of the Interior (FR 48:190). No further cultural resource surveys in the canyon area would be initiated by the Corps until following authorization of this plan.

AGRICULTURAL/PRIME AND UNIQUE FARMLANDS

Construction related to this alternative would not affect any farmlands in the project area.

HAZARDOUS AND TOXIC WASTE

No-Action Conditions

The No-Action Condition is the same as described under Operational Impacts of the Detention Dam Plan.

Significance Criteria

For purposes of this analysis, any action which substantially increases the risk of an uncontrolled release of hazardous or toxic materials into the environment is considered a significant impact.

Impacts

There is a potential that hazardous or toxic substances could be released into the upper American River area during the activities related to construction of the flood control project.

Hazardous or toxic materials, such as gasoline, diesel, and oil needed to run construction equipment, would be controlled at the construction site. Contractors would be required to submit a plan for the proper handling and management of these hazardous materials to prevent accidents that threaten the safety of workers as well as the water quality of the American River.

Mitigation

Control of hazardous or toxic materials, such as gasoline, diesel, and oil needed to run construction equipment, would be necessary at each construction site. Contractors would

be required to submit a plan for the proper handling and management of these hazardous materials to prevent accidents that threaten the safety of workers as well as the water quality of the adjacent waterways. The following describes mitigation measures needed to prevent substantial release or spill of toxic materials at construction sites and reduce potential impacts to a less-than-significant level.

Access. Restrict public access to construction sites to prevent access for dumping and vandalism which could result in the release of toxic materials.

Potential Onsite Contamination. An assessment to further evaluate the potential for existing onsite contamination at each construction site would be accomplished prior to construction. Subsurface sampling would be conducted to evaluate the magnitude of contamination. A review of existing environmental records with the Department of Health Services would be conducted. Such a review would help identify where hazardous materials may have been dumped in the levee improvement areas and in the upper American River area.

If stained soil or other indications of hazardous materials are revealed during construction, all work would be stopped. The suspect soil or liquids should be analyzed and disposed of appropriately at an approved disposal facility.

TRANSPORTATION

No-Action Condition

The No-Action Condition is the same as described under operational impacts for this alternative.

Significance Criteria

The significance criteria is the same as described under operational impacts for this alternative.

Impacts

Construction aspects of the dam, including concrete placement, disposal of unsuitable aggregate materials, stabilizing Ponderosa Way bridge, and the Highway 49 bridge replacement, would result in a number of short-term transportation impacts in the Auburn area. Dam construction and disposal activities are expected primarily at the damsite.

Some materials other than aggregate would have to be transported to the damsite over public roads. The use of large slow-moving trucks could cause significant capacity-related

conflicts, particularly if construction vehicles operate during peak traffic periods. In addition, some construction vehicle routes may lack adequate turning radii, and heavy equipment could cause damage to road surfaces. These transportation impacts are considered potentially significant and subject to mitigation.

Material would be moved to the proposed disposal sites over existing dirt access roads. This traffic would not use local roadways and thus would not affect local roadways except during transport of required equipment to the project site.

Likewise, construction of a new Highway 49 bridge would create additional construction-related vehicle trips along the existing roadway and in the Auburn area. Under the Detention Dam Plan, this bridge would be placed at river mile 49.1, a location which retains, to the extent feasible, the existing alignment of the highway while ensuring that the roadway is high enough to satisfy State gradient requirements and permit clearance of the maximum inundation level of the flood detention dam. During construction, access would continue to be provided via a detour along the existing alignment; however, some delays beyond those currently experienced would occur where the new alignment departs the existing alignment. These delays, however, would occur over the short term and be intermittent and of short duration. Consequently, impacts to transportation are considered less than significant.

As explained in chapter 10, the Detention Dam Plan alignment has been selected as in-kind replacement for the Highway 49 bridge. The State of California has indicated it will do route adoption studies. These studies may lead to the selection of an alternate alignment based on the long-term transportation needs of the area independent of the flood control project.

Construction activities related to the railhead area would be limited to daylight hours when individuals are generally not at home. This would be a short-term adverse effect which would not be mitigated.

Mitigation

The contractors shall prepare a transportation plan with information on haul routes and the number of trucks per day, as well as a traffic engineering analysis indicating that potential affected intersections have adequate turning radii for oversized vehicles.

AIR QUALITY

No-Action Condition

The upper American River portion of the project area is in the Mountain Counties air basin, under the jurisdiction of the Placer County Air Pollution Control District. All of Placer County, except that segment in the Lake Tahoe air basin, has been designated as a nonattainment area for ozone and unclassified for PM10.

Because of the direction of prevailing air currents and the action of the Sierra range as a climatological barrier, the Auburn area is subject to heavy influence from air contaminants originating in the Sacramento area, as well as from agricultural burning activities in the valley. Traffic on I-80 and Highway 49 and local industries are also significant sources of air pollution.

Significance Criteria

According to appendix G of the State CEQA Guidelines, a project will normally have a significant effect on the environment if it will violate any ambient air-quality standard, contribute substantially to an existing or projected air-quality violation, or expose sensitive receptors to substantial pollutant concentrations.

Significance criteria developed by the SMAQMD and by the EPA were used in determining the significance of project-related air-quality impacts. Project-related emissions were considered significant if emissions exceeded the SMAQMD's thresholds of:

- 85 pounds per day (ppd) of ROG,
- 85 ppd of NO_x, or
- 275 ppd of PM10 (Sacramento Metropolitan Air Quality Management District 1994).

Also, project-related annual emissions were considered significant if emissions exceeded EPA's general conformity thresholds. Those conformity thresholds are based on the de minimis thresholds included in EPA's general conformity guidance regulation for the Sacramento area (40 CFR Part 51 Subpart W and 40 CFR Part 93 Subpart B). The threshold levels equal:

- 25 tons per year for ROG
- 25 tons per year of NO_x,
- 100 tons per year for CO, or
- 100 tons per year for PM10.

Impacts

Under the proposed action, emissions would be produced during construction of the Auburn dry dam and from raising and strengthening levees along the lower American River and the Sacramento River. Emissions from dam construction would include fugitive dust from aggregate mining, processing, and transporting and exhaust emissions produced by variety of heavy-duty construction equipment. In addition, a segment of Highway 49 in Placer and El Dorado Counties would have to be relocated. This relocation would also produce air emissions. A 6-year construction period would be required to complete all these construction activities. In addition, the new segment of Highway 49 would slightly reduce travel times in portions of Placer and El Dorado Counties, affecting mobile source emissions in these areas.

Table 9-3 summarizes annual CO, ROG, NO_x, SOx, and PM10 emissions for the proposed action. Emissions would exceed the daily emission thresholds for ROG, NOx, and PM10 and the annual emission threshold for ROG, Nox, and CO. This is considered a significant impact.

Upper American River

Emissions from dam construction would include fugitive dust from aggregate mining, processing, and transporting, and exhaust emissions produced by a variety of heavy-duty construction equipment. Air-quality modeling has shown that construction emissions of NO_x would exceed the threshold level by 100 to 125 tons. CO and NO_x emissions are within threshold levels. In addition, the new segment of Highway 49 would slightly reduce travel times in portions of Placer and El Dorado Counties; this would not significantly affect mobile source emissions in these areas.

Lower American River

Emissions along the lower American River would be generated from construction activities involved in raising and strengthening existing levees. All emissions are within the threshold levels.

TABLE 9-4

Construction Equipment Emissions
Detention Dam Plan

Year	Carbon Monoxide CO		Reactive Organic Compounds ROG		Nitrogen Oxides NO_x		Sulfur Oxides SO_x		Inhalable Particulate Matter PM10	
	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day	Tons per Year	Pounds per Average Work Day
2000	250	2,676	38	268	619	5,394	61	581	116	1,601
2001	241	2,917	37	307	598	6,016	59	650	114	1,647
2002	149	2,573	25	268	372	5,185	34	558	99	1,345
2003	151	3,057	19	364	358	7,197	38	776	101	1,470
2004	148	2,687	19	340	351	6,286	38	679	100	1,413
2005	153	2,939	18	351	358	6,902	38	743	101	1,449
2006	0	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	30	570
2008	0	0	0	0	0	0	0	0	30	467
2009	0	0	0	0	0	0	0	0	30	386
2010	0	0	0	0	0	0	0	0	0	0
Maximum	250	3,057	38	364	619	7,197	61	776	116	1,647

Folsom Reservoir

The proposed action would not generate any air emissions in the Folsom Reservoir area.

Lower Sacramento River

Emissions along the lower Sacramento River would be generated from construction activities involved in raising and strengthening existing levees along the Sacramento River. Table 9-4 summarizes annual CO, ROG, and NOx for all areas of construction. Emissions are within threshold levels along the lower Sacramento River.

Mitigation

(1) Prepare and Implement a Dust Suppression Plan

The Corps will prepare a dust suppression plan and submit it to the SMAQMD/Placer County Air Pollution Control District/El Dorado County Air Pollution Control District for review before initiating construction. The plan will include as many of the following mitigation measures as are applicable to each project site:

- Cover, enclose, or water active storage piles at least twice daily.
- Cover inactive storage piles.
- Pave all haul roads.
- Cover securely or maintain at least 2 feet of freeboard on all haul trucks when transporting material.
- Water all active construction sites at least twice daily. Frequency should be based on the type of operation, soil, and wind exposure.
- Maintain the natural topography to the extent possible to eliminate the need for extensive land clearing, blasting, ground excavation, grading, and cut-and-fill operations.
- Prohibit all grading activities during periods of high wind (greater than 30 miles per hour).
- Apply chemical soil stabilizers on inactive construction areas (disturbed lands within construction projects that are unused for at least 4 consecutive days).

- Apply nontoxic binders (for example, latex acrylic copolymer) to exposed areas after cut-and-fill operations and hydroseed area.
- Plant tree windbreaks on the windward perimeter of construction projects if they are adjacent to open land.
- Plant vegetative ground cover in disturbed areas as soon as possible.
- Install wheel washers for all exiting trucks.
- Sweep streets if visible soil material is carried onto adjacent public roads.
- Post a publicly visible sign at the project site to specify the telephone number and person to contact regarding complaints. This person shall be responsible for responding to complaints and taking corrective action within 48 hours.

(2) Control Dust Emissions from Aggregate Mining

Aggregate mining will generate emissions from rock mining, crushing, screening, and conveying. Several of these activities will require a permit from the Placer County Air Pollution Control District. The following measures should be implemented to minimize emissions from aggregate mining. For the underground mining operations, the ventilation exhaust should be fitted with a fabric filter and/or a fog or water spray system to control dust releases. For the aboveground aggregate conveyor system, the conveyor should be enclosed to minimize dust generation. All aboveground aggregate transfer points should include a water spray system to control dust releases.

(3) Incorporate NO_x mitigation measures into construction plans.

- Require injection timing retard of 2 degrees on all diesel vehicles, where applicable.
- Install high-pressure injectors on all vehicles, where feasible.
- Encourage the use of reformulated diesel fuel,
- Use Caterpillar prechamber diesel engines (or equivalent) together with proper maintenance and operation.
- Electrify equipment, where feasible.
- Maintain equipment in tune with manufacturer's specifications, except as otherwise stated above.

- Install catalytic convertors on gasoline-powered equipment.
- Substitute gasoline-powered for diesel-powered equipment, where feasible.
- Use compressed natural gas or onsite propane mobile equipment instead of diesel-powered equipment, where feasible.

Air-Quality Conformity

The Detention Dam Plan is potentially subject to both the general and transportation conformity regulations. The applicability of the transportation conformity rule arises from relocation of Highway 49 in Placer and El Dorado Counties. Reconstruction of bridges (such as the Howe Avenue Bridge) is exempt from the transportation conformity requirements.

Currently, the Detention Dam Plan emissions are not included in SACOG's implementation plan (Young, pers. comm.). This is considered a significant air-quality impact.

Mitigation

The Corps should submit the Highway 49 relocation project to SACOG for incorporation into the MTIP. Once the relocation project has been incorporated into the MTIP, SACOG will be required to show that the MTIP conforms to the Sacramento Metropolitan Area's State Implementation Plan. This mitigation measure will reduce the impact to a less-than-significant level.

As shown in table 9-4, emissions associated with the Detention Dam Plan exceed the tons per year conformity thresholds established by the EPA. Consequently, a conformity analysis is being conducted to show that the Detention Dam Plan would not violate the Sacramento area's SIP for CO and ROG. NO_x emissions are above the threshold; emission offsets would be purchased to mitigate this effect to a less than significant level.

NOISE

No-Action Condition

Noise levels in El Dorado and Placer Counties where dam construction, replacement of Highway 49, and the strengthening of Ponderosa Way Bridge are proposed are relatively low. Noise levels in nearby communities are typical of low density urban areas and are

primarily traffic related. Other noise sources include sounds produced from the river current, birdsong, and recreational users.

Significance Criteria

The noise impact analysis was prepared in accordance with "Guidelines for Noise Study Reports as Part of Environmental Impact Reports" issued by the California Department of Health Services, Office of Noise Control.

Site inspections, accepted noise modeling techniques, and existing noise data were used to assess project-generated noise impacts. Site inspections were conducted to identify noise sources and to locate noise-sensitive land uses in the nearby vicinity. Noise-sensitive land uses were typically considered to be residential, educational, church, library, and health-related facilities; significant noise sources included surface traffic, railroads, industries, and aircraft.

Noise impacts were assessed at each of the sites by comparing project-generated construction and operational noise levels, existing noise levels, and the criteria and standards contained in applicable planning documents. The criteria applicable in this case are primarily for noise-sensitive residential uses and are intended to provide a suitable environment for indoor communication and sleep. The noise standard which would apply to each project improvement site is contained in the General Plan Noise Element for that respective jurisdiction. All respective noise elements cite 60 dBA L_{dn} as the established daytime residential noise standard. Short-term construction-generated noise is normally exempt from these noise standards. Nevertheless, potential noise impacts on sensitive receptors must be evaluated. For the purposes of this report, impacts are considered significant if project-generated noise levels would exceed the above-adopted noise standard in areas of sensitive receptors.

Impacts

This alternative would require aggregate mining at the previous Auburn Dam site. During mining, a number of noise-generating sources would be in operation. Some of the sources would be intermittent and some constant; some sources would be stationary; others would be mobile.

Construction activities related to the railhead area would be limited to daylight hours when individuals are generally not at home. This would be a short-term adverse effect which would not be mitigated.

Major sources of noise generation would be drilling rigs, blasting, crushing, and loading and hauling equipment. Overall, noise generation could also be expected during

nighttime hours due to high production rates necessitated by the construction schedule (8-year construction period).

Construction and mining activities, especially blasting and operation of heavy equipment, would create temporary noise increases near the damsite. Initially, temporarily increased noise levels can be anticipated from the development/construction and later during operation of the conveyor transport system used to move material from the processing plant to the dam face. Because they are powered by electricity, the conveyor motors would cause only minor noise impacts. Noise from these motors, however, combined with noise generated from conveyor apparatus (belts, pulleys, and rollers) and the aggregate itself as it vibrates during transport, is anticipated to increase the ambient noise levels within the canyon area immediately adjacent to the conveyor system.

Existing background noise levels in the canyon area are assumed to be relatively low. Noise sources are limited to sounds produced from river current, birdsong, aircraft, and recreational users, and, in some areas, vehicular traffic on Highway 49. Noises associated with the conveyor are expected to increase ambient noise levels heard by nearby recreational users and wildlife. However, because operational noises are not expected to affect sensitive receptors or significantly disrupt existing uses along the conveyor route, these impacts are considered adverse but less than significant.

Aggregate handling and processing and small stationary noise sources have lower initial noise levels, so their corresponding noise impact zones are much smaller. Noise emissions from haul trucks, compressors, and pumps are generally attenuated to acceptable levels within 500 feet of the noise source. Smaller, discrete sources such as generators and compressors are also more readily controlled with heavy-duty mufflers designed to minimize noise generation.

Construction activities at the Highway 49 replacement site and the damsite would also generate construction noise from heavy-duty equipment similar to the equipment listed in figure 7-1. However, these impacts would not be significant because these work sites are isolated, and there are few nearby noise-sensitive receptors. Construction-related traffic would be generated in the Auburn area, but until the numbers and types of transport equipment are known, the extent of noise generated by those activities cannot be determined. Consequently, construction noise impacts at the damsite and Highway 49 bridge site would be considered short-term adverse, but less than significant.

Mitigation

Heavy-equipment and railcar or truck noise would be the major concern during levee-related and dam construction activities. Primary sources of noise in these cases are engine exhaust, fans, transmissions, and other mechanical equipment. Heavy equipment is typically fitted with mufflers and engine enclosures to allow operation in noise-sensitive areas. Thus, the source of noise may be controlled within technological limits by requiring adequate mufflers and enclosures to be maintained on heavy equipment and other noise-producing tools.

When reasonably controlled, construction noise is often accepted by the public during daytime hours (7 a.m. to 5 p.m.). People are less tolerant of noise and may complain if nonemergency construction activities continue at night. Preventing nighttime construction near noise-sensitive receptors can effectively reduce public concerns.

The following measures, therefore, are recommended to reduce the project's short-term construction-related noise impacts on adjacent noise-sensitive land uses.

- Mufflers shall be provided for all project-related heavy construction equipment and stationary noise sources (such as diesel generators). Stationary noise sources shall be located at least 300 feet from occupied residences or contractors shall be required to provide appropriate noise-reducing engine-housing enclosures.

- Equipment warmup areas, water tanks, and equipment storage areas shall be placed in a central area as far away from existing residences as is feasible.

Aggregate production and processing at the damsite, including blasting, would create temporary noise increases near the construction site. To help reduce noise impacts to nearby residences, blasting would be limited to daytime hours. However, other processing activities would be required about 20 hours each day for the dam construction period. Thus, noise impacts associated with aggregate production would be significant and unavoidable.

Background ambient noise levels would also increase in areas adjacent to the conveyor route; however, no sensitive receptors are located near the conveyor alignment. Consequently, these impacts would remain adverse but less than significant.

Delivery at the railhead would be limited to daylight hours.

Construction-related traffic noise can be reduced at noise-sensitive receiver locations by ensuring that all traffic complies with applicable noise emission standards. Traffic routing can often be selected to minimize exposing these areas to heavy truck traffic.

To reduce the project's mobile source construction noise impacts, the following measures are recommended.

- All onroad mobile construction vehicles (dump trucks) shall be equipped with mufflers.
- All dump truck haul trips shall follow only the haul routes analyzed in this report unless a waiver is received from the appropriate agency.
- No dump truck haul trips shall be allowed in residential areas before 8 a.m. or after 6 p.m.

The above mobile source noise mitigation measures would reduce project-generated mobile source noise to the greatest extent feasible. Residual impacts would be considered adverse but less than significant for residential areas near the damsite.

VISUAL RESOURCES

No-Action Condition

Visual resource values in the upper American River canyon area are high. Visual resource values in areas where construction work associated with dam construction, replacement of Highway 49, and the strengthening of Ponderosa Way bridge is proposed are low due to construction disturbance from Reclamation's multipurpose dam.

Significance Criteria

For a project component to have a significant impact, the project or features of a project would change the visual quality of sensitive viewing components within the observable scene. A large number of viewers would notice a significant change to the character of an existing setting. Such changes may include a project feature significantly blocking a desirable viewing component or replacing valuable environmental resources previously regarded as a visual amenity.

Impacts

Lower American River. The lower American River area would be affected by the construction of a slurry wall in about 24 miles of existing levees. This would cause short-term visual disruption along the river.

Downstream From American River. Approximately 12 miles of levees on the east side of the Sacramento River between the Natomas Cross Canal and the mouth of the American River would be strengthened and raised.

Upper American River. In the first years of the project, the activity of heavy equipment and construction workers would be noticeable in the construction vicinity. Visual disruption would be easily sensed in construction areas. As project construction continues, the detention dam would increase in size. Completion of the dam would result in a structure 508 feet high crossing the canyon. This would result in a significant unavoidable impact.

The bridge and approaches for Highway 49 would be raised above the inundation zone. Associated construction activities would have temporary adverse effects to visual resources. The completed bridge would be similar to the existing Foresthill bridge just upstream on the North Fork. This would result in a significant unavoidable impact.

Mitigation

Following levee work, levees would be seeded with an erosion-control mix of grasses and forbs which would offset visual effects. The dam structure and relocated highway would result in significant visual impacts which could not be feasibly mitigated to less than significant.

CUMULATIVE IMPACTS

For the purposes of this analysis, the cumulative impacts which would result from the Detention Dam Plan were assessed by listing the projects which would produce impacts similar to those which would result from this alternative along the lower American and Sacramento Rivers and their tributaries. A discussion of these cumulative impacts is contained in chapter 10.

The Detention Dam Plan would return the operation of Folsom Reservoir to the 1987 Diagram, resulting in the flood reservation being 400,000 acre-feet each year. This diagram would eliminate the need to replace water and hydropower forgone as a result of implementing the 1993 Diagram. The constraints on recreational opportunities from the slightly lower reservoir levels during the period of reoperation would be eliminated by returning the operation to the 1987 Diagram. The mitigation structures provided by SAFCA would remain in place.

GROWTH-INDUCING IMPACTS

The Detention Dam Plan was formulated to neither promote nor prohibit expansion for permanent water storage at the Auburn site. Expansion to a multipurpose dam project with a permanent pool would significantly increase vegetative losses, geomorphological changes, and related impacts over those identified for the Detention Dam Plan.

A multipurpose project could be implemented in one of two possible ways: (1) construction of a multipurpose facility independent of flood control proposals on the American River (authorized and built instead of flood-control-only facilities or at a different location from the proposed flood detention dam) or (2) expansion of a flood-control-only dam sometime in the future. The growth-inducing section of chapter 10 highlights the features required to expand a proposed flood control project to a multipurpose dam and summarizes the potential impacts of a large multipurpose dam under either method of authorization. This discussion draws heavily on the previous environmental work completed by Reclamation for the full-sized multipurpose Auburn Dam.

Flood plain development in the Sacramento area would be the same under this plan as under the No-Action Alternative.

Construction of the Detention Dam Plan would not result in an increase in the growth expected in the Auburn area under the Placer and El Dorado County general plans. Relocating Highway 49 to a higher elevation in the canyon would not shorten the time required to access the I-80 corridor to commute into Sacramento.

SUMMARY OF IMPACT CONCLUSIONS AND ENVIRONMENTAL COMMITMENTS

LAND USE

There would be no significant adverse effects on land use in the project area.

RECREATION

Impacts

Relocation of Highway 49 would eliminate the need to keep the old alignment open. This would adversely affect the recreational use of the confluence area.

Mitigation

Road access would be maintained to the confluence area at local cost as a recreation feature.

FISHERIES

Construction and operation of the Detention Dam Plan would not result in significant adverse impacts in the canyon area.

VEGETATION AND WILDLIFE

Impacts

The compensation objective for this mitigation project is the replacement of acreage of vegetative cover types projected to be lost as a result of construction and operation of the proposed flood detention dam. Based on an assessment of impacts, the following acreages, by cover type, would be lost: 1,149 acres of oak woodland, 110 acres of chaparral, 86 acres of mixed pine forest, 201 acres of nonnative grassland, and 136 acres of riparian habitat, for a total of 1,682 acres lost.

ENDANGERED SPECIES

Impacts

Operation of the detention dam could adversely affect the elderberry shrubs and beetle by temporarily inundating portions of the North and Middle Fork canyons where the host plant is found. Surveys located 210 shrubs, primarily along the Middle Fork. Of this total, beetle emergence holes were found in 73 shrubs. The inundation period is expected to be a maximum of 21 days. It is possible that 103 shrubs could be lost over the period of analysis and would result in a significant adverse impact.

Lower American River and Downstream From American River

Active Swainson's hawk nests could be destroyed or disturbed during construction activities along the Sacramento River under the Detention Dam Plan. Loss of nests or disturbance to nests resulting in loss of eggs or death of young would adversely affect the Swainson's hawk.

Construction activity along levees in the Natomas area under the Detention Dam Plan could kill hibernating giant garter snakes.

Mitigation

Compensation for the beetle would be provided by the non-Federal sponsor in accordance with FWS guidelines. The study concluded that 1,143 stems greater than 1 inch in diameter would be affected. At a 3:1 ratio, 3,429 seedlings would need to be established. For an expected mortality rate estimated to be approximately 50 percent, 7,008 seedlings would be planted in the lands designated for adaptive management.

To avoid effects to the Swainson's hawk, the Corps would implement seasonal restrictions on construction activity according to DFG guidelines for mitigating effects on the Swainson's hawk (DFG, 1994).

Seasonal restrictions on construction activities (October 1 through May 1) to potential habitat of the giant garter snake would be implemented according to California Department of Fish and Game guidelines (1992). Construction within giant garter snake habitat would be restricted to nonhibernating periods.

CULTURAL RESOURCES

Impacts

Periodic, temporary inundation of the canyon area could cause substantial site disturbance to the 180 sites.

Mitigation

Impacts from temporary inundation, including bank sloughing, wave action, and a new zone of wet-dry cycling, could be reduced by data recovery, documentation, and structural protection, but not to a less than significant level.

TRANSPORTATION

Impacts

Relocating Highway 49 and constructing a flood detention dam near Auburn would cause periodic flooding of the replaced Highway 49 along its present alignment where it crosses the North Fork of the American River.

Mitigation

The relocated Highway 49 corridor could be used for access to the confluence of the North and Middle Forks should a non-Federal entity choose to maintain the road.

AIR QUALITY

Impacts

Constructing the detention dam would produce a variety of emissions, including fugitive dust from aggregate mining and processing and emissions from equipment used to raise and strengthen the levees along the Sacramento and American Rivers, construct the dam, and relocate Highway 49. These activities would be conducted over an 8-year period.

Mitigation

Prepare and implement a dust suppression plan for the construction areas. An Air Quality Conformity Plan will be prepared and coordinated with the appropriate agencies in Placer, El Dorado, and Sacramento Counties.

NOISE

Impacts

This alternative would cause significant increases in the ambient noise levels in the vicinity of the damsite from quarrying, excavating the foundation, and running the concrete mixing facility, as well as from engine noise from construction equipment.

Mitigation

To avoid or reduce the increase in ambient noise levels, the construction equipment will be equipped with appropriate mufflers, and stationary sources will be shielded. The increase in noise levels from construction and quarrying will result in significant and

unavoidable effect that may not be mitigated to a less than significant level. This impact is temporary and will only last for the duration of the construction.

VISUAL RESOURCES

Impacts

Construction of this alternative would result in an increase in the level of activity from building the dam and erecting the concrete batch plant. As the dam construction continues and the structure approaches its ultimate size, an imposing concrete structure would be built in this relatively natural-appearing canyon setting. Relocating Highway 49 to a higher elevation would result in the construction of a high-level bridge crossing the canyon well above the riverbed.

Mitigation

The area around the dam would be restored using native vegetation to repair construction access roadways and work areas which are not needed for operation purposes. No mitigation is anticipated which would reduce the impact of the dam and bridge to a less-than-significant level.

SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Unavoidable impacts which cannot be mitigated to a less-than-significant level include possible impacts on cultural resources and impacts to the visual character of the canyon.

SIGNIFICANT IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Construction of the Detention Dam Plan would result in irreversibly committing aggregate and associated materials for dam concrete.

EFFECTS FOUND TO BE SIGNIFICANT

The summary tables at the beginning of this SEIS/EIR list potential impacts and proposed mitigation.

CORPS RESPONSES TO FWS RECOMMENDATIONS

GENERAL COMMENT

The U. S. Fish and Wildlife Service (FWS) submitted a draft Supplemental Fish and Wildlife Coordination Act (FWCA) report for the American River Watershed Project (ARWP) in May 1995. The report supplements FWS 1991 FWCA report. The entire section of FWS recommendations is presented below, with Corps responses below each recommendation.

> The recommendations contained within this section constitute what the Service believes, from a fish and wildlife resource perspective and consistent with our Mitigation Policy, to be the best present recommendations for the project. The outcomes of any new or renewed consultations, as required under Section 7 of the Endangered Species Act or the Fish and Wildlife Coordination Act, could also affect the recommendations herein. Rationales for most of the recommendations were discussed earlier within this report.
>
> The Council on Environmental Quality and the Service's Mitigation Policy define mitigation as including the following elements: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time, and compensating for impacts. The Service considers these elements to represent the most desirable sequence of steps in the mitigation planning process. In determining when to move from any one element to the next in the sequence, success or failure of particular techniques or approaches in the past under similar circumstances (as reflected in the results of previous (e.g., DeWeese 1994) mitigation evaluation studies) are taken into account. Our preferred alternative for mitigation of project impacts is to avoid them altogether. Following are our recommendations for (1) actions relative to the American River Watershed Investigation as a whole, (2) actions specific to the Stepped Release Plan, and (3) actions specific to the Corps' Detention Dam Plan.

GENERAL RECOMMENDATIONS

FWS Comment: We recommend that adverse impacts be minimized by selecting a flood control alternative which avoids unmitigatable impacts to fish and wildlife resources. At present, this plan would be either increased Folsom Modification or the Stepped Release Plan.

Corps' Response: The non-Federal sponsors of the project, the Sacramento Area Flood Control Agency and the State of California Reclamation Board, in conjunction with the Corps, have thoroughly considered all the alternative plans, including the Folsom

Modification Plan and the Stepped release Plan. Based on final recommendations of governing boards and headquarters review, the project proponents have selected the Detention Dam Plan as both the NED plan and the locally preferred plan. Regardless of the plan selection, full compensation, to the extent practicable, will be provided.

FWS Comments: We recommend that adverse impacts be minimized by selecting a flood control alternative which avoids unmitigable impacts to fish and wildlife resources. At present, this plan would be either increased Folsom storage or the Stepped Release Plan.

Corps' response: The non-Federal sponsors of the project, Sacramento Area Flood Control Agency and the State of California Reclamation Board, have identified the Detention Dam Plan as the Locally Preferred Plan. This plan has also been identified as the National Economic Development Plan by the Corps.

FWS Comment: The following recommendations are provided pursuant to Section 7 of the Endangered Species Act.

a. Determine potential effects of the project on listed or proposed species or critical habitat, by conducting surveys for the species or potential habitat, as appropriate.

b. Should the species or critical habitat be present, complete a Biological Assessment for the Project and determine whether the species would be affected.

c. Should the proposed action be likely to affect the species or its critical habitat, initiate formal consultation with the Service.

Corps' response: The Corps has initiated formal Section 7 consultation by forwarding a Biological Assessment to FWS. Recommendations that would reduce the likelihood of listed species being adversely affected by the project are also included in the Corps' Biological Data Report (appendix K).

DETENTION DAM PLAN

FWS General Comment

Our current recommendations relative to this alternative are similar to those presented in 1991, with changes that reflect (1) focus on the previous NED Plan rather than the smaller Equivalent Storage Plan dam, (2) authorization of Natomas levee construction, (3) findings of the WLRC (Washington Level Review Center) on the Auburn HEP in 1992, and (4) our recent mitigation assessment (appendix F). As discussed earlier, we do not believe there are

sufficient suitable lands available in the ecoregion to mitigate the impacts of either the Equivalent Storage Plan or the Detention Dam Plan.

FWS Comment: To assure adequate evaluation of impacts to fish and wildlife of any future expansion of a flood-control-only dam at Auburn, the authorizing document for the Detention Dam Plan include a statement that any alteration of flood-control-only facilities or project purpose be authorized by additional legislation, and that biological impact analyses of a permanent storage facility be completed prior to such authorization. Include, in all environmental documentation, all cumulative impacts of conversion to a water supply reservoir.

Corps' Response: The detention dam would be designed to neither impede nor facilitate subsequent expansion of the facility into a multipurpose project providing permanent water storage and related water supply, hydropower, flatwater recreation, and instream flow benefits. Such an expansion would require separate Congressional action based on appropriate environmental review of the impacts of permanent water storage in the project area. A programmatic evaluation of the cumulative impacts which could result from the incremental effects of expanding the detention dam into a multipurpose facility providing permanent water storage is included in the DSEIS/SDEIR.

FWS Comment: To compensate the loss of 2,360 acres of riverine canyon and upland wildlife habitat due to direct project-induced impacts in the American River canyon, acquire and manage 11,560 acres for fish and wildlife in an area suitable for revegetation of all lost habitat types.

Corps' Response: The analysis conducted by the Corps, SAFCA, and the State determined that approximately 1,682 acres of oak woodland, mixed pine forest, chaparral, and riverine habitats would be lost as a result of constructing and operating the detention dam and relocating Highway 49. A total of 1,481 acres along the canyon bottom would be purchased for use as an adaptive management plan, and 2,962 acres along the Yuba River near Englebright Lake would be purchased and planted with appropriate species. Mitigation plantings would be at a density of 200 trees per acre and would also include mitigation for lost habitat of the threatened valley elderberry longhorn beetle.

FWS Comment: Mitigate for fish habitat losses by placement of log barriers, downfall trees, and rock gabions to create pools and instream cover, and by stabilization and revegetation of slipouts and removal of sediment resulting from sloughing of canyon walls.

Corps' Response: The Corps does not agree with this recommendation. Operation of the detention dam would not alter the available fisheries habitat in the American River canyon. The increased capacity of the outlet sluices has eliminated ponding in the basin from storms less than a 20-year return frequency, and the use of operational gates to control the release rate for larger storms will eliminate the drawdown-induced sloughing. As noted above, the

impacts to vegetation from inundation mortality will be mitigated using the adaptive management plan approach.

An ancillary benefit of the adaptive management plan is that storm damage to recreational trails and roadways leading to the river would be repaired to assure continued access to recreational facilities and mitigation planting areas. This would stabilize the trail and road cuts, reducing the likelihood of a slide during subsequent events.

FWS Comment: To mitigate increased sedimentation and resultant stream habitat degradation in the lowest elevation zone (490-800 feet), stream habitat be improved above Lake Clementine and above streambed elevation 800 feet in the Middle Fork. Preparation of a long-term fishery management plan in consultation with the California Department of Fish and Game and the Fish and Wildlife Service would be needed prior to any revegetation efforts, or efforts associated with Recommendation 3, above.

Corps' Response: The Corps does not agree with this recommendation. See the response above. The lands adjacent to the river are the lands which would be purchased for management with the adaptive management plan. The details of the adaptive management plan would be closely coordinated with FWS and DFG prior to implementation.

FWS Comment: To minimize any additional impacts to the remaining wildlife lands in the project inundation zone, a wildlife management plan be developed cooperatively by the Department of Fish and Game, the Service, and the Corps, and implemented throughout the project life.

Corps' Response: The Corps, SAFCA, and the State will work closely with FWS and DFG to assure that impacts to wildlife in the inundation zone are minimized.

FWS Comment: To mitigate the impact of canyon wall sloughing and resultant river sedimentation, slipouts be stabilized by revegetating with indigenous species, sediment be removed from the channel, and the streambed be recontoured to normal gradient. Work should be done promptly after sloughing. Planning and implementation of slipout repair should be coordinated with the Service and the California Department of Fish and Game.

Corps' Response: The Corps does not agree with this recommendation. Operation of the sluice gates would control the drawdown rate from the dam. This would virtually eliminate drawdown-induced sloughing. To minimize direct impacts from sedimentation and incidental spillage during construction, temporary measures should be implemented to divert natural streamflows from the active construction sites. This would make construction easier in the dewatered channel and would minimize contact of potentially harmful materials with the river. Installing a network of temporary interceptor dikes and ditches at construction sites

would convey sediment-laden flows into temporary settling basins, and the clarified water would be discharged to the river.

FWS Comment: Develop detailed mitigation, monitoring, and remedial action plans for each mitigation action and site. Coordinate all phases of mitigation plan development and implementation with the Service and California Department of Fish and Game.

Corps' Response: A mitigation and monitoring program has been developed by the Corps, SAFCA, and the State and is described in chapter 5.

FWS Comment: Address any impacts to Federal and State-listed and candidate species resulting from project-induced agricultural or urban development within the appropriate environmental documentation for this project. Initiate the appropriate consultation with the Service, as required under the Endangered Species Act, for such potential effects on listed species.

Corps' Response: The Corps has initiated the process required by Section 7 of the Endangered Species Act by submission of the Corps' Biological Assessment to FWS. Although there would be no project-induced development, the Corps will address all potential direct, indirect, project-induced growth, and cumulative impacts in the DSEIS/SDEIR.

CHAPTER 10

SPECIAL TOPICS

The purpose of this chapter is to compare the environmental and related impacts which would result from implementing the reoperation scenarios proposed under the Folsom Modification Plan and the Folsom Stepped Release Plan to the Baseline condition which existed prior to Folsom Reservoir being reoperated in accordance with the agreement between SAFCA and
Reclamation

FEDERAL PARTICIPATION IN PERMANENT REOPERATION OF FOLSOM RESERVOIR

Implementation of the temporary agreement between SAFCA and Reclamation to change the operation of Folsom Reservoir from the Baseline condition of 400,000 acre-feet of fixed flood storage reservation to a flexible storage reservation of between 400,000 and 670,000 acre-feet has resulted in impacts to several resource categories. SAFCA has provided mitigation for the impacts which would result from the 5-year period of the agreement. The operation of 400,000 and 670,000 acre-feet is the No-Action Alternative to which the action alternatives are compared for determining project impacts and mitigation requirements.

However, this results in breaking the impacts of changing the operation from 400,000 to 400,000/670,000 acre-feet for No-Action, or to 475,000/720,000 acre-feet of storage for the Folsom Modification Plan, into smaller increments, none of which are significant. The impacts from permanently reoperating Folsom Reservoir using the rule curve have been identified and evaluated and are discussed in chapter 6 for the No-Action Alternative (the impact discussion also covers the reoperation component of the Stepped Release Plan, since reoperation under this plan is the same) and chapter 7 for the Folsom Modification Plan.

Should the Federal Government authorize a project which includes a permanent reoperation component, mitigation would likely be provided for the impacts of changing from the Baseline condition of 400,000 acre-feet of fixed storage to the Stepped Release Plan (400,000 to 670,000 acre-feet) or the Folsom Modification Plan (475,000 to 720,000 acre-feet) as these would be the impacts for which mitigation would be provided should either plan become the authorized Federal project.

Each of the candidate plans were evaluated against the No-Action Alternative. The No-Action Alternative includes changing the flood control operation of Folsom reservoir from 400,000 acre-feet of fixed storage to a variable operating curve of between 400,000 and

670,000 acre-feet of space, depending on the amount of incidental storage space available in the upstream private reservoirs. The Folsom Modification Plan and the Folsom Stepped Release Plan both recognize that this reoperation of Folsom Reservoir would either continue unchanged under the Stepped Release Plan, or be increased under the Folsom Modification Plan. However, neither plan identifies or evaluates the environmental consequences of permanently reoperating Folsom Reservoir to the 400,000 to 670,000 acre-foot level.

If either of these alternatives becomes the alternative selected for Federal participation, it is probable that the non-Federal sponsors would request that the costs of permanently reoperating Folsom Reservoir to 400,000 to 670,000 acre-feet of variable storage be included as a project feature. Should this occur, the costs for mitigating for those impacts would be included. This section identifies the impacts which would result under both plans and identifies potential measures to compensate for the losses associated with permanent reoperation. This analysis uses the 400,000 acre-foot operating rule curve as the baseline condition and compares the effects of permanently instituting the 400,000 to 670,000 acre-foot flexible flood storage operation (No-Action Alternative) to it, thereby characterizing the effects of permanent reoperation. The effects of permanently instituting the 475,000 to 720,000 acre-foot flexible flood storage operation (Folsom Modification Plan) are summarized following the discussion related to the No-Action Alternative.CUMULATIVE

COMPARISON OF NO-ACTION TO BASELINE CONDITION

Permanent reoperation of Folsom Reservoir using the 400,000 to 670,000 acre-foot flexible storage diagram would result in significant impacts to the same resources discussed for the No-Action Alternative.

RECREATION

Baseline

Lower American River. This area is used by approximately 6.5 million visitors annually. Boating (rafting, canoeing, and kayaking), swimming and wading, and fishing are important water-dependent recreation activities along the lower American River, accounting for approximately for approximately 1.5 million visitors together. Approximately 90 percent of all boating and swimming on the lower American River takes place between Memorial Day and Labor Day. Fishing is a year-round activity. The remaining usage is from land based activities such as bicycling, jogging, and walking.

Boating, swimming, and wading are affected by flows and water temperature. Low flows typically affect boating by reducing stream velocity, so river-travel time and congestion increase. Swimming and wading opportunities can be limited by the number of usable areas along the river, which decrease during periods of low flow, and low water temperatures during periods of high flow.

Fishing opportunities along the lower American River are affected by the abundance of sport fish (chinook salmon and steelhead trout).

Folsom Reservoir. Folsom Reservoir supports numerous water-based activities such as boating, waterskiing, and fishing. The shoreline provides sandy swimming beaches, both formal (with lifeguard services) and informal. Surrounding Folsom Reservoir is a landscape with important scenic, natural, and cultural values. Recreational facilities include camping and picnic areas, boat launch ramps, restrooms, concessions, bicycle and mountain bike trails, and equestrian trails and staging areas.

Most visitation at Folsom Reservoir is in the summer, (approximately 2,298,000) when recreation focuses primarily on water-based activities, including swimming, windsurfing, fishing, boating, boat camping, jetskiing, and scuba diving. Winter visitation is substantially lower, and use consists mainly of fishing and passive recreation.

Water-surface elevations directly affect the availability and quality of boat ramps, beaches, berth sites, and other facilities which depend largely on water depth or surface area. As these facilities become unavailable to users, use patterns and visitation is altered. In addition, visual resource values closely associated with the recreational experience are affected by water-surface elevations and influence how, and the degree to which, recreationists use the resources of Folsom Reservoir.

Upper American River. Reclamation contracted with the Department of Parks and Recreation to provide recreation and public-use management services on the lands within the boundaries of the multipurpose Auburn Dam project, known as the ASRA (Auburn State Recreation Area). The ASRA includes 42,000 acres and 48 miles of the American River from the damsite to the Iowa Hill bridge on the North Fork to Oxbow Reservoir on the South Fork. The ASRA is visited by approximately 500,000 recreationists per year.

Its nearness to major population centers and diverse recreation base make the ASRA one of the most-used and significant recreation resources in northern California. Local interest in recreation is very heavy. Bicycling has increased dramatically in the area. There is continuing demand for equestrian trails and other trails. The Tevis Cup horse race and the Western States Run, both 1-day, 100-mile events, use the Western States Trail from Auburn to Squaw Valley. These events draw entrants from around the world. Whitewater boating on the Middle and North Forks of the American River is of State and national significance. Both forks offer overnight camping opportunities, hiking trails, cultural and natural observation sites, and a diversity of difficulty in whitewater rapids from beginning to advanced boating skill levels. The nearby South Fork of the American River offers a less challenging whitewater experience, and because of the predominance of private lands and development along the river corridor, camping is restricted. The nearest similar "wilderness" whitewater river, providing overnight trips, is the Tuolumne River, about 100 miles southeast of the recreation area. Approximately 72 miles of hiking trails, 66 miles of equestrian trails, and 15 miles of fire road are open to mountain bikes in the ASRA and provide year-round recreation opportunities.

Significance Criteria

Impacts on boating, swimming, fishing, and wading were considered significant if changes in flows or water temperature would result in a 10 percent reduction in recreational use when compared to the 400,000 acre-foot Condition.

Impacts

Lower American River. Impacts on boating, swimming, and wading were considered significant if changes in flows or water temperature would result in a 10 percent or greater reduction in recreation use, measured in visitor days, by comparison to the 400,000 acre-foot condition. Impacts on sport fishing were considered significant if changes in the abundance of sport fish in the lower American river would substantially change from the 400,000 acre-foot Condition.

For purposes of evaluating the impacts of the No-Action Alternative on recreation in the lower American River, a use model was developed based on minimum and optimum flow and temperature thresholds for boating and swimming. This model was used to compare use patterns under the 400,000 acre-foot condition and No-Action Alternative during the Memorial Day to Labor Day period for all 69 years in the hydrologic record. For boating activities, minimum thresholds would be achieved 78 percent of the time, and optimum thresholds would be achieved 55 percent of the time under the 400,000 acre-foot condition. These figures would decline by 1 percent to 77 percent and 54 percent under the No-Action Alternative.

For swimming activities, minimum thresholds would be achieved 81 percent of the time, and optimum thresholds would be met 52 percent of the time under the 400,000 acre-foot condition. Under the No-Action Alternative, the minimum threshold would be met 82 percent of the time (an increase of 1 percent), and the optimum threshold would be met 52 percent of the time (no change).

Under the No-Action Alternative, temperature and flow fluctuations would result in little change in the quantity and quality of fish habitat relative to the 400,000 acre-foot condition. Because fish habitat would not be substantially affected, it is assumed that sportfishing opportunities would not change from those under the 400,000 acre-foot condition.

Based on this analysis, impacts on recreation along the lower American River under the No-Action Alternative are considered less than significant because the frequency with which important thresholds for swimming and boating would be achieved would be similar to the frequency under 400,000 acre-feet conditions, and temperature and flow fluctuations are not expected to substantially change the availability of sport fish.

Folsom Reservoir. Impacts to Folsom Reservoir recreation were evaluated based on establishing larger reservoir elevations for boating and swimming activities during the peak (April-August) and offpeak (September-March) seasons for all (69) years in the hydrologic

record. Activities, measured as visitor days, were correlated to the target elevations based on a use model developed by the California Department of Parks and Recreation. The 400,000 acre-foot condition and No-Action Alternative models were run to generate comparative visitor-day totals. This evaluation indicated that total use during the peak season would decline by approximately 25,000 visitor days, or about 1.1 percent of total use. This would not be a significant impact under the significance criteria established for this impact category.

Reductions in offpeak season use would be numerically smaller but would constitute a higher percentage reduction for the affected months. However, the total reduction in use for the offpeak season would be less that 10 percent and thus would not constitute a significant impact under the applicable criteria.

Clair Engle Reservoir. Target reservoir storage elevations for recreational activities were established for Clair Engle Reservoir and used to compare use under the 400,000 acre-foot condition and the No-Action Alternative. This comparison showed recreation opportunities based on optimal boat ramp availability and lake surface area would be unchanged. The No-Action Alternative caused recreation opportunities during periods of limited boat ramp availability to decline by 1 percent. This is not considered a significant impact.

Other CVP/SWP Reservoirs. Impacts at other recreation areas within the CVP/SWP system (for example, Shasta Lake, Lake Oroville, the Sacramento River, and the Delta) were not assessed quantitatively because hydrologic modeling output for the 400,000 acre-foot Condition and the No-Action Alternative indicated only small incremental changes in reservoir levels and river flows.

All boat ramps would be out of operation 1 percent of the time during the peak season and 2 percent of the time during the off-season. Boat ramp availability would be limited 31 percent of the time during the peak-use season and 80 percent of the time during the off-season. Usable surface area for boating would become constrained 13 percent of the time during the peak-use season and 37 percent of the time during the off-season. The lake elevation would fall below the optimal level for boating 47 percent of the time during the peak-use season.

This impact would be reduced to a less than significant level by extending a low-water boat ramp as proposed by Reclamation and SAFCA as part of interim reoperation of Folsom Dam and Reservoir.

Cumulative impacts must also be considered relative to impacts associated with the construction or implementation of other similar or related projects. Chapter 6 discusses potential cumulative impacts relative to reoperation through a discussion of similar or related water supply projects. Chapter 8 discusses potential cumulative impacts associated with the construction features of this project through a discussion of other levee improvement or flood control projects.

Mitigation

No significant impacts to recreation facilities or opportunities were identified for the Stepped Release Plan; consequently, no mitigation is required.

FISHERIES

Baseline

Lower American River. The Baseline in the lower American River is considered to be only marginal for anadromous fish production, especially during low-flow years. Increased water temperature, decreased water quality, reductions in the quantity and quality of spawning gravel, and a decline in hatchery production contribute to this potential reduction of the anadromous fishery resource.

Fall-run chinook salmon continue to be the primary species of management concern in the lower American River. This approach reflects the consensus reached by participants in Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge Decision)—a consensus which included as management priorities ". . . maximize the in-river production (that is, spawning, juvenile survival) of chinook salmon in the Lower American River" and ". . . maximize the in-river production of steelhead trout to the extent that it does not interfere with chinook salmon management." However, because NMFS received a petition on February 14, 1994, to list steelhead trout throughout its range in Washington, Idaho, Oregon, and California, the issue of management priorities in the lower American River merits additional discussion.

High water temperature during summer and fall is the environmental factor that is the most limiting to natural production of steelhead trout in the lower American River (Snider and Gerstung, 1986; DFG, 1991c). Historically, steelhead trout migrated upstream to their primary spawning and rearing areas in the upper forks of the American River and its tributaries. In these upper reaches of the American River system, juvenile steelhead trout reared for at least 1 year before migrating downstream to the Pacific Ocean. Cool water temperatures in the upper reaches of the system made this extended rearing component of their life history possible. Today, the historical spawning and rearing areas are inaccessible to steelhead trout, and, due to dam construction, spawning and rearing in the American River system is restricted to the lower American River—an area subjected to elevated water temperatures. Consequently, it is believed that few juvenile steelhead trout survive through the summer and fall (DFG, 1991c).

In addition to the river itself, high water temperatures at the Nimbus Fish Hatchery during late summer and fall are problematic for rearing steelhead trout, even during good water years. High water temperatures promote the growth of disease organisms. Treatments for these diseases are expensive and contribute significantly to the cost and ineffectiveness of raising steelhead trout to yearling size (DFG, 1991c). Currently, modernization plans for the

hatchery do not address the problems of high water temperatures during summer and fall at the hatchery. There are no formal plans or processes under way to resolve the problem of high water temperatures (DFG, 1991c).

Folsom Reservoir. Folsom Reservoir operations under the 400,000 acre-foot Condition adversely affect resident warmwater species in two ways. First, the water-surface elevation in Folsom Reservoir is reduced from full pool elevation by an average of 39.3 feet between June and September, a critical time in year-class development. Such drawdowns eliminate an average of 2,567 surface acres of water (25.6 percent of total), much of which is in sheltered coves containing flooded terrestrial vegetation. This loss of juvenile rearing habitat resulting from summer drawdown is thought to have the greatest negative effect on annual production of fish in Folsom Reservoir (D. Lee, DFG pers. comm. 1994). Second, fluctuations in water levels cause dewatering and flooding of nests and reduce the spawning success. As a result, annual production of bass, sunfish, crappie, bullhead, and catfish is low, and the population of these species tends to be marginal compared to those found in similar natural reservoirs that do not suffer such wide fluctuations in water level.

Upper Sacramento River. NMFS has determined that a daily average water temperature of less than or equal to 56 °F is required in the Sacramento River between Keswick Dam and Bend Bridge from April 15 through September 30 to protect winter-run chinook salmon spawning and incubation. NMFS, in its 1993 biological opinion, specified a minimum flow release criteria for October through March of 3,250 cfs at Keswick Dam.

Significance Criteria

For purposes of evaluating the impacts of the No-Action Alternative on fishery conditions, it is assumed that a 10 percent exceedence criteria based on the 400,000 acre-foot Condition would constitute a significant impact.

Impacts

Under the No-Action Alternative, the frequency with which lower American River flows would meet or exceed the Hodge flows would increase by 5 percent in October through February, decrease by 1 percent in March through June, and remain unchanged in July through September. Chinook salmon spawning flows may improve slightly. In general, flow impacts on physical habitat in the lower American River would be similar to those under the Baseline.

Water Temperature Impacts. An analysis of daily exceedence frequencies based on the historical relationship between reservoir storage, lower American River discharge, and maximum daily water temperatures in the lower American River was not required because the alternatives to be analyzed include operation of the temperature control device at Folsom Dam, which is expected to alter the relationship among lake level, discharge, and water temperature.

Chinook Salmon. Under the No-Action Alternative, the frequency with which monthly water temperatures would exceed optimal water temperatures for chinook salmon spawning and incubation in October and November would be increased by 0-2 percent (depending on distance downstream from Nimbus Dam) compared to the Baseline. The frequency with which temperatures at Nimbus Hatchery would exceed 56 °F (based on monthly water temperatures at Nimbus Dam) would increase by 2 percent. Therefore, no significant changes would occur in temperature impacts on in-river and hatchery production of chinook salmon.

A slight decrease or no change in exceedence frequencies would occur in the spring relative to the chinook salmon rearing and emigration threshold. Therefore, water temperature impacts on chinook salmon rearing and emigration success would not change significantly relative to the Baseline.

Steelhead Trout. Under the No-Action Alternative, the frequency with which monthly water temperatures would exceed optimal water temperatures for steelhead trout spawning and incubation would decrease by 3 percent at Nimbus Dam and remain unchanged at the downstream stations relative to the Baseline.

As under the Baseline, monthly water temperatures in summer would continue to exceed the rearing threshold in all years. A 2 percent increase or no change would occur in exceedence frequencies relative to the steelhead trout emigration threshold. Therefore, no significant adverse impacts on steelhead trout rearing and emigration success would occur.

American Shad, Striped Bass, and Sacramento Splittail. Under the No-Action Alternative, no changes would occur in the frequency with which monthly water temperatures would exceed spawning temperature thresholds for American shad, striped bass, and Sacramento splittail. Therefore, water temperature impacts on the spawning success of these species would be similar to those under the Baseline.

Flow Fluctuation Impacts. Under the No-Action Alternative, the frequency of flow reductions of 50 percent or more during the chinook salmon spawning and incubation period would remain unchanged in October through January and increase by 1 percent in November through February and December through March. The frequency of 50 percent flow reductions during the steelhead trout spawning and incubation period would increase by 1 percent in January through April and 6 percent in February through May. Therefore, redd stranding impacts on chinook salmon and steelhead trout were considered less than significant.

Potential stranding impacts on Sacramento splittail would be similar to those under the Baseline. The frequency of reductions in river stage of 1 foot or more would decrease by 1 percent during the principal splittail spawning and early rearing period.

Folsom Reservoir

Black Bass Spawning and Rearing Habitat. Median differences in black bass habitat values would be zero to 1 percent. No significant changes in black bass spawning and rearing success would occur.

Spawning Success of Warmwater Fish. Under the No-Action Alternative, the frequency of reservoir drawdowns of two feet or more per month during the primary spawning months for warmwater game fish (March through July) was reduced by 1 percent during the 70-year simulation period. Therefore, impacts of reservoir drawdown on spawning success of warmwater game fish would be similar to those under the Baseline.

Coldwater Fish Habitat. Under the No-Action Alternative, average monthly reservoir storage would be reduced by 2 to 7 percent in December through March, increased by 2 percent in September and October, and reduced by zero to 1 percent in the remaining months. Reductions in reservoir storage during winter are not expected to cause significant adverse impacts on the reservoir trout fishery because coldwater habitat is unlikely to be limiting the abundance of stocked trout, especially during the cooler months of the year when the reservoir is thermally mixed. Lower reservoir storage during the winter may actually improve feeding opportunities for rainbow trout by increasing prey availability.

Upper Sacramento River. Under the No-Action Alternative, flow impacts on fishery resources in the upper Sacramento River would be similar to those under the Baseline. No change would occur in the frequency with which flows would meet the October through March minimum release criterion of 3,250 cfs at Keswick Dam.

A slight decrease or no change would occur in the frequency with which monthly water temperatures would exceed the chinook salmon spawning and rearing thresholds in the upper Sacramento River, including those established for winter-run chinook salmon spawning and rearing. Therefore, temperature impacts on chinook salmon spawning and rearing success in the upper Sacramento River would be similar to those under the Baseline.

Downstream from American River. Implementing the No-Action Alternative would have little or no effect on flow and water temperature impacts on fisheries resources in the lower Sacramento River would be similar to those under the Baseline. Changes in average monthly flow at Freeport would be 1 percent or less in all months.

Impacts of Delta outflows and total Banks and Tracy exports on fisheries resources would be similar to those under the Baseline. Changes in average monthly Delta outflow and exports would be 1 percent or less in all months.

Shasta Reservoir. Implementing the No-Action Alternative would have little or no effect on Shasta Reservoir fish habitat and populations. Average monthly reservoir storage differed by less than 1 percent from storage levels under the Baseline.

No change would occur in the frequency with which September storage levels would meet the carryover storage criteria for water temperature control in the upper Sacramento River. Therefore, storage-related water temperature impacts on winter-run salmon spawning success would be similar to those under the Baseline.

Clair Engle Reservoir. Implementing the No-Action Alternative would have little or no effect on changes in reservoir storage on reservoir fish habitat or populations. Changes in average reservoir storage would be less than 1 percent in all months.

The frequency of flow reductions of 50 percent or more during the chinook salmon spawning and incubation period would remain unchanged in October through January, increase by 8 percent in November through February, and remain unchanged in December through March. The frequency of 50 percent flow reductions during the steelhead trout spawning and incubation period would increase by 3 percent in January through April and increase by 10 percent in February through May. Therefore, redd stranding impacts were considered significant for steelhead trout and potentially significant for chinook salmon.

Mitigation

No significant impacts on fisheries resources under the Stepped Release Plan; consequently, no mitigation is required.

VEGETATION AND WILDLIFE

Baseline

Lower American River. As previously described, the natural processes that support and maintain stands of riparian vegetation and the associated riparian wildlife community were substantially altered in the lower American River by the construction of Folsom and Nimbus Dams. The flow regime and typical annual hydrograph for which the riparian vegetation was adapted has changed such that annual high flows no longer coincide with the time many of the riparian species such as cottonwood and willow shed their seed. In addition, the dams have blocked the transport of much of the upstream sediment. Consequently, deposition of sediment along the banks of the lower American River during high flows, which is necessary for providing an adequate seed bed suitable for the establishment of riparian plants, has been minimized. The elimination of sediment transported from upstream has also resulted in increased erosion and transport of sediment out of the lower American River and incision of the river channel. This condition has led to the migration of the river away from the existing riparian community. Hence, the dams have impaired natural regeneration of the riparian community along the lower American River and the ability of the river to support existing vegetation.

Wetland areas in the river's side channels and isolated ponds have also been affected by changes in the river's flow regime over time. As the river channel continues to meander,

wetlands dependent upon recharge from floodwaters and/or ground water supported by streamflow may be eliminated or flooded permanently. Similarly, long-term abundance and distribution of sensitive plant and wildlife species associated with riverine and riparian habitats, as well as the wildlife community as a whole, may change in response to changes in the riparian community.

Significance Criteria. Specific threshold criteria were used for identifying potentially significant impacts. A project will normally have a significant impact on plants and wildlife if it will substantially affect a rare or endangered species of animal or plant or the habitat of the species; interfere substantially with the movement of any resident or migratory wildlife species; or, substantially diminish habitat for wildlife and plants.

Riparian vegetation is adapted to an environment characterized by change (for example, extreme variation in streamflows) rather than stability. Hence, minor variations in the flow regime in this type of environment are not likely discernible. The potential impacts on vegetation and wildlife associated with the No-Action Alternative have been evaluated within this context.

Impacts. The No-Action Alternative would generally result in increased flows during late fall and early winter as flood storage is increased in the reservoir and reduced flows during the spring while the reservoir is refilled. This change in the existing flow regime will not influence, either detrimentally or beneficially, the riparian community's ability to regenerate. Therefore, the focus of the impact analysis is on maintenance of existing vegetation and wetlands.

Existing riparian vegetation can be affected by changes in flow in several ways:

(1) Reduction in spring flow that prevents recharge of backwater channels and isolated ponds;

(2) Inundation for extended periods during the growing season;

(3) Change in the flow regime such that the frequency of low-flow conditions during the growing season is increased; and,

(4) Change in the frequency, duration, and depth of peak floodflows that promote cottonwood and willow regeneration on flood plain terraces.

Based on the requirements of the 1993 Diagram, flows under the No-Action Alternative will differ from those under the Baseline only infrequently (≤ 12 years) during January and May through December. Additionally, the flow differences during these months were generally minor. In February, March, and April, flows under the No-Action Alternative differed from the Baseline in 43, 33, and 20 of the 70 years evaluated, respectively. Although February showed the highest frequency of flow differences, the magnitude of the flow change would be minor.

An analysis of the frequency of modeled flows (at 500 cfs intervals) during each month over the entire period of record indicated that the frequency of flow levels between 3,000 and 3,500 cfs during March and April is higher under the No-Action Alternative than under the Baseline and lower for flows between 3,500 and 8,500 cfs. There were no differences at flows below 3,000 cfs.

Pond and Backwater Recharge. The riparian vegetation associated with the numerous side channels and isolated ponds along the lower American River is dependent in large part on annual recharge of these areas by high flows in the spring. Reduced spring flows could affect the ability of these areas to recharge. From field studies conducted on the lower American River, Sands (1985) concluded that flows of 2,750 cfs and 4,000 cfs were necessary to recharge the ponds closest to and farthest from the river channel, respectively. The physical solution outlined by Judge Hodge in the *EDF et al. v. EBMUD* decision, which took into consideration the study results of Sands (1985) and others, requires maintaining a flow level of at least 3,000 cfs during the spring to protect lower American River resources, including riparian vegetation and adjacent pond communities. This flow level was used as the threshold criterion for significance.

In dry water years when pond recharge may be reduced, riverflows under the No-Action Alternative would not differ from the Baseline. Specifically, reservoir operations under the 1993 Diagram would not increase the frequency of flows below 3,000 cfs. In wetter years, flow levels may be reduced, but would not fall below 3,000 cfs during March through June, the growing season for vegetation along the ponds. Accordingly, no significant adverse impacts to riparian vegetation are anticipated as a result of failure to recharge backwater areas under the No-Action Alternative.

Seasonal Inundation. During the primary growing season, March through June, the frequency of inundation of nearshore vegetation would not increase under the No-Action Alternative. In all modeled years, flows were equal to or less than those under the Baseline during March through June. Hence, no adverse impacts on riparian vegetation are expected. During periods of reduced activity (September through January), the No-Action Alternative would result in only minor changes in flow which would not significantly alter the frequency of inundation.

The maximum objective release from Folsom Reservoir will remain at 115,000 cfs. During extreme storms, the overbank areas would be flooded to near the levee tops, as happens under the 1986 operating diagram. When this happens, mobile wildlife species escape to dry areas outside the levees. Nonmobile or hibernating individuals would be killed. This is no change from the Baseline.

Water Availability. Because of past channel incision and the migration of the river channel away from stands of riparian vegetation, extreme low-flow conditions may reduce moisture in the root zone in areas supporting existing riparian vegetation. As with backwater and pond recharge, the 3,000 cfs flow level contained in the Hodge Decision was intended to provide an adequate level of protection for existing riparian vegetation.

Therefore, the 3,000 cfs flow level was used as the criterion for maintaining existing vegetation. Under the No-Action Alternative, flow levels during March through June are identical to the Baseline in dry years when flows are below 3,000 cfs. In the remaining years, flows are always equal or in excess of 3,000 cfs. Therefore, the No-Action Alternative is not expected to adversely affect riparian vegetation.

Wildlife. The riparian plant community and wetlands along the lower American River will not be significantly affected under the No-Action Alternative. The wildlife community associated with these habitats is not expected to change. With respect to the riparian and open water species such as piscivorous birds (for example, mergansers, herons, egrets, and kingfishers) which are dependent upon fisheries, a no-impact finding is appropriate based on the determination (discussed above) that the No-Action Alternative would not adversely affect lower American River fisheries.

Lake Natoma. Lake Natoma serves as a regulating afterbay that moderates releases from Folsom Reservoir. Operation of Lake Natoma will not change as a result of the No-Action Alternative, and fluctuations in water-surface elevation will not differ from the Baseline. Therefore, no significant impact on the riparian vegetation, wetlands, and wildlife associated with Lake Natoma is expected.

Folsom Reservoir. As described in the environmental setting, Folsom Reservoir supports a minimal amount of riparian vegetation in the drawdown zone because of the widely fluctuating water-surface elevations resulting from reservoir operation. Typical riparian vegetation does exist where tributary streams enter the reservoir; however, this vegetation is supported primarily by streamflow rather than reservoir level. Because of the recent drought, portions of the drawdown zone have been exposed for a sufficient duration to allow the temporary establishment of some vegetation (primarily willows). These vegetated areas will be lost when reservoir levels rise in response to wetter hydrologic conditions. Accordingly, the No-Action Alternative would not affect riparian vegetation at Folsom Reservoir.

Wetlands do not exist within the drawdown zone, although the FWS (1992) identified established backwater marsh areas in the reservoir that are normally inundated but may become dewatered under reoperation. These areas, which exist primarily near the upper arms, provide habitat for migrating waterfowl during winter. In wet years, these backwater marsh areas may not be inundated due to an increased drawdown. However, the frequency of dewatering of these areas would not substantially increase under the No-Action Alternative. Therefore, there would be no significant impact to this vegetation or to waterfowl using these habitats.

Mitigation

No significant impacts were identified for the No-Action Alternative; consequently, no mitigation is required.

ENDANGERED SPECIES

Baseline

A complete discussion of listed species which may be affected by the No-Action Alternative may be found in chapter 4. Table 4-2 lists sensitive plant and wildlife species, their scientific names, and their status.

Significance Criteria

For the purposes of this analysis, any action undertaken directly in connection with, or indirectly caused by, the project which would affect the continued existence of a threatened or endangered species is considered a significant adverse impact.

Impacts

Lower American River. The sensitive species described in chapter 4 for the lower American River are the same as would be affected under this alternative.

Folsom Reservoir. The sensitive species described for the lower American River, with the exception of the bald eagle, either do not occur in or near the reservoir or will not be affected by permanent reoperation.

Bald eagle. Bald eagles are known to use Folsom Reservoir during winter. Impacts resulting from the No-Action Alternative could be expected if the project caused a substantial reduction in the warm and/or cold water fishery in Folsom Reservoir. The No-Action Alternative would not result in a substantial reduction in the Folsom Reservoir fishery. Therefore, a reduction in the bald eagle prey base is not expected. Although habitat suitability at Folsom reservoir may be decreased, a significant impact on bald eagles is not expected for two reasons. First, the number of eagles and the extent to which the area is used is very low. Second, wintering bald eagles are extremely mobile and have the ability to exploit food sources over a wide geographic range. Thus, it is doubtful that the potential reduction in habitat suitability at Folsom Reservoir would inhibit the ability of wintering bald eagles to obtain food.

Shasta Reservoir. The No-Action Alternative could alter water-surface elevations and storage levels in Shasta Reservoir. Changes in water-surface elevations would affect nearshore habitats and the distance between upland habitats and the water's edge. Nearshore areas of Shasta Reservoir support little vegetation and, consequently, are of limited value to wildlife. Changes in the distance between upland habitats and the water's edge, however, could affect bald eagle foraging at the reservoir.

Bald eagle. In most years, water-surface elevations would not differ between the No-Action Alternative and the Baseline. In the few years that water-surface elevations would be reduced, the reductions would be minor. The maximum reduction in water-surface elevation was 7.5 feet. However, reductions in water-surface elevations were less than 3 feet in most years when reductions occurred. In only 5 months of the entire period of record were water-surface elevations reduced by more than 5 feet. These minor and infrequent reductions in water-surface elevations would not result in a significant impact to bald eagle foraging.

Clair Engle Reservoir.

Bald eagle. As with Shasta Reservoir, potential impacts to wildlife at Clair Engle Reservoir would be limited to potential adverse effects on bald eagle foraging success. Bald eagles nest and overwinter at Clair Engle Reservoir, and, therefore, could be affected by reduced water-surface elevations throughout the year. In most years, water-surface elevations in Clair Engle Reservoir would not differ between the No-Action Alterative and the Baseline. In the few years that reoperation would reduce water-surface elevations, the reductions would be minor, less than 3 feet. The minor and infrequent reductions in water-surface elevations would not result in a significant impact to bald eagle foraging.

Mitigation

Because the impact to endangered species would be infrequent and insignificant, no mitigation would be required.

CULTURAL RESOURCES

Baseline

Lower American River. In the lower American River area, 42 archeological sites, 7 historic properties and 3 potentially historic railroad bridges have been identified in the lower American River area. Because the entire area has not been systematically inventoried, many more previously unidentified sites are certain to exist there. Four properties are listed in or eligible to be listed in the National Register of Historic Places, and few of the remaining properties have been evaluated for National Register eligibility. Under the 400,000 acre-foot Condition, these properties, particularly the archeological sites, are subject to numerous adverse impacts, many of which are severe, including alluvial erosion and vandalism. In addition, flooding in excess of the current level of protection could cause significant damage to a number of the prehistoric and historic archeological sites along the terraces of the lower American River. Similarly, emergency discharges in excess of the current objective release of 115,000 cfs could result in significant damage to sites.

Folsom Reservoir. Several surveys and studies have been conducted since the construction of the dam. At least 123 prehistoric sites and approximately 52 historic era

properties have been recorded. Primary archival and secondary sources suggest that more than 200 other potential sites or features may exist in the reservoir (Peak and Associates, 1990). Because the entire area has not been systematically inventoried, many more previously unidentified properties may be present. The Folsom Powerhouse is the sole property at the reservoir which is listed or eligible to be listed on the National Register of Historic Places. Under the 400,000 acre-foot Condition, these sites are subject to numerous adverse impacts, many of which are severe, including erosion caused by wave action, vandalism, alternate drying and inundation, and damage by offroad vehicles.

Upper American River. Previous studies have documented 1,589 historic and 125 prehistoric archeological sites in the Auburn area. Included among the cultural properties in this area are numerous manmade structures which must be evaluated for National Register of Historic Places eligibility. Under the 400,000 acre-foot Condition, these resources are subject to the effects of pluvial, eolian, and, to a lesser extent, alluvial erosion. In addition, they are under moderate to severe pressure from vandalism and recreational activities.

Downstream from American River. Two prehistoric archeological sites and a single historic period archeological site exist within the area downstream from American River. In addition, numerous historic period structures exist there, including the Sacramento Weir, a National Register of Historic Places-eligible property, and other unevaluated properties. No notable adverse impacts are known to be occurring with respect to these cultural properties under the current operating regime.

Significance Criteria

For the purposes of the this analysis, impacts to cultural resources are considered significant if the affected property is a site, building, structure, or object which is recognized as culturally or historically significant based on the following institutional, public, or technical criteria. The criteria are explained in detail in chapter 4.

Impacts

Lower American River. The vast majority of sites along the lower American River corridor are currently undergoing severe erosion associated with both natural processes, such as root and rodent intrusion, as well as man-induced effects such as fluctuating river levels. Increased population, land use, and related urban growth along the river corridor would continue generally as described in current local plans. Vandalism has been noted at several sites and is expected to continue. Similarly, the recreational opportunities afforded by the American River Parkway introduce additional elements of looting and collecting. Thus, the above-listed factors will continue to subject historic properties to adverse impacts under current conditions, (the No-Action Alternative).

Folsom Reservoir. Changes in water-surface elevations in Folsom Reservoir under the current operating regime have severely damaged most of the cultural sites within the

inundation zone of the reservoir (Waechter and Mikesell, 1994). This would continue under the No-Action Alternative.

Based on information from the California Historical Resources Information Center, 143 known sites in the Folsom Reservoir inundation zone could be affected under without-project conditions. Additional sites that have not been identified in previous surveys also may exist. Of the 143 known sites, 35 are located within 0.25 mile of designated recreation areas and are therefore subject to a higher degree of disturbance than those farther away.

Under 400,000 acre-foot condition conditions, all the 143 known sites and any unidentified sites would continue to be subjected to effects caused by wave action, vandalism, alternating drying and inundation, and inadvertent damage by offroad vehicles.

The same number of sites would be exposed to various potential impacts under both the 400,000 acre-foot condition conditions and the No-Action Alternative. The only difference between 400,000 acre-foot condition conditions and the No-Action Alternative is the degree of impact. However, a review of the hydrologic modeling for 400,000 acre-foot condition conditions and the No-Action Alternative indicates that the differences in the level of impacts would be minor. In general, sites at higher elevations would be exposed to the greatest levels of impact, both from wave action and from human actions.

One known site in the Folsom Reservoir inundation zone would not be affected by exposure-related impacts. The remaining 142 sites would continue to be affected by wave action and exposure similar to the effects described under 400,000 acre-foot Condition conditions. An unknown number of additional cultural resource sites that have not been identified also could be similarly affected. Implementing either of the alternatives would contribute slightly to the ongoing significant effects on cultural resources. This contribution to ongoing effects is considered significant.

Downstream from American River. No adverse impacts are anticipated to historic properties in the Sacramento River area.

Shasta Reservoir. Changes in water-surface elevations in Shasta Reservoir under the No-Action Alternative would be less than those experienced in Folsom Reservoir. In about 85 percent of the 840 months of the period of record, water-surface elevations would differ from the 400,000 acre-foot Condition by less than 1 foot (appendix G). In about 10.5 percent of the months, water-surface elevations would be 1 to 3 feet lower, and in the remaining 4.5 percent of the months, water-surface elevations under the No-Action Alternative would be 3 to 8 feet lower. Due to the low magnitude and infrequent occurrences of differences in water-surface elevations between the No-Action Alternative and the 400,000 acre-foot condition, sites of historical or cultural significance along the shoreline of Shasta Reservoir would not be subjected to a substantial increase in exposure or wave action. Therefore, no significant impacts to cultural resources at Shasta Reservoir would occur under the No-Action Alternative.

Clair Engle Reservoir. Changes in water-surface elevations in Clair Engle Reservoir under the No-Action Alternative relative to the 400,000 acre-foot condition would be minor and infrequent. In about 96.4 percent of the 840 months of the period of record, water-surface elevations would differ from the 400,000 acre-foot condition by less than 1 foot (appendix G). In the remaining 3.6 percent of the months, water-surface elevations under the No-Action Alternative would be 1 to 3 feet lower. Due to the low magnitude and infrequent occurrences of differences in water-surface elevations, sites of historical or cultural significance along the shoreline of Clair Engle Reservoir would not be subjected to a substantial increase in exposure or wave action. Therefore, there would be no significant impacts to cultural resources at Clair Engle Reservoir.

Mitigation

Compliance with the National Historic Preservation Act would reduce the potentially significant impacts on Folsom Reservoir sites likely under the No-Action Alternative to a less than significant level. The SHPO has recommended that a Research Design be prepared to serve as a foundation for determinations of eligibility for inclusion of Folsom Reservoir sites into the National Register of Historic Places. The research design would also serve to identify additional areas for inventory. Future actions to achieve compliance with the National Historic Preservation Act call for preparing an agreement document; field work to aid in the determinations of eligibility process; developing a Findings of Effects document; and preparing a treatment plan for select resources and select treatment, including stabilization of appropriate sites.

WATER QUALITY

Baseline

Water quality along the lower American River is generally good to excellent for all beneficial uses. However, dissolved oxygen and temperature do not meet some beneficial objectives during low-water years when flows in the river are reduced. These low flows periodically result in high water temperatures that may jeopardize juvenile fish. Runoff from the portions of the lower American River area north of the river is collected and discharged into the American River. Runoff from areas south of the river is collected and discharged into the Sacramento River.

Significance Criteria

For purposes of this analysis, any degradation in water quality below relevant standards established by the Regional Water Quality Control Board or EPA would constitute a significant impact.

Impacts

American River Basin. Water-quality problems, including low dissolved oxygen concentrations and microorganism blooms that contribute to taste and odor problems in domestic water supplies, are largely attributable to elevated water temperatures. In Folsom Reservoir, these problems occur during the summer when storage falls below about 400,000 acre-feet and water temperatures exceed about 70 °F. The No-Action Alternative would not significantly increase the frequency at which these conditions would be expected.

Water quality in the lower American River is also affected by elevated water temperatures. However, for the reasons discussed above, the No-Action Alternative would not significantly increase the potential for conditions detrimental to water quality in the lower American River.

Sacramento River Basin/Delta. Reclamation is required under the 1994 Bay Delta Standards to maintain water quality standards in the Delta. Compliance with the conditions in the 1994 Bay Delta Standards was an inherent assumption in the hydrologic modeling performed in connection with this SEIS/EIR.

Mitigation

No significant impacts on water quality in Folsom Reservoir on the lower American River under the No-Action Alternative; consequently, no mitigation is required.

VISUAL RESOURCES

Baseline

Lower American River. The lower American River provides a variety of visual experiences, which include steep bluffs, terraces, islands, backwater areas, and riparian vegetation. The natural environment is a refreshing contrast to the urban development of the surrounding Sacramento area.

Folsom Reservoir. Folsom Reservoir visual resources have been demonstrably negative in their natural appearance for much of the last decade, to the extent that the existing "bathtub ring" of exposed shoreline is an unappealing, and therefore negative, viewscape.

Upper American River. There would be no adverse effects to visual resources in the upper American River area.

Downstream from American River. The visual resource values of the Sacramento River system are varied and represent a complex setting of geomorphic landscapes, vegetative communities, and open and confined waterways.

Shasta and Clair Engle Reservoirs. Both Shasta and Clair Engle reservoirs are conserved under the National Recreation Area objectives which protect lands of recreational and scenic value (U.S. Department of Agriculture, 1987). Although human-made, these reservoirs have been established for many years and when full, appear essentially natural. They are both surrounded by coniferous forest. Typically, though, the reservoirs have not been full due to drought. The visual quality of the reservoirs is degraded during low water years as the drawdown zone detracts from the scenery. Shasta Reservoir can be viewed by passers-by on Interstate 5, therefore, it is exposed to significantly more viewers than is Clair Engle Reservoir.

Significance Criteria

Evaluation of visual quality often results in a subjective discussion that reflects the values and priorities of those performing the analysis. Several criteria are used to evaluate visual impacts, including the qualities of vividness, intactness, and unity. Definitions for the criteria used include the following:

- "Vividness" is the visual power or memorability of landscape components as they combine in striking and distinctive visual patterns.
- "Intactness" is the visual integrity of the natural and manmade landscape and its freedom from encroaching elements. This factor can be present in urban and rural landscapes and natural settings.
- "Unity" is the visual coherence and compositional harmony of the landscape considered as a whole. It frequently attests to the careful design of individual components in the manmade landscape.

If, based on these criteria, the project would (1) induce a substantial, demonstrable negative visual effect; (2) result in the creation of an aesthetical offensive site open to public view; (3) significantly change the existing visual quality of the region; or (4) eliminate visual resources, it would be identified as having a significant impact. Reduction in water-surface elevation of 10 feet or more is discernible to most of the general public, and a reduction of 15 feet or more is demonstrably negative and would be considered significant.

Impacts

Folsom Reservoir. Under the Baseline, aesthetics of Folsom Reservoir and the State Recreation Area would remain subject to the same natural and operational regimes to which they are now subject. Visual resource impacts would not exceed that range normally expected. The visual resource impacts of permanent reoperation should, therefore, be considered, since the reservoir has been aesthetical impaired for some time.

Summer Season Impacts. Under the No-Action Alternative, reservoir water-surface elevations would only be reduced in 6 months of the summer recreation period of record (350 months [April-August for 70 years]) by an amount ranging from 2.4 to 6.1 feet. This low frequency of occurrence (1.4 percent) and low magnitude (up to 6.1 feet) of reduced elevations does not represent a significant adverse effect to visual resources.

Winter Season Impacts. In the winter recreation season (September-March), reservoir surface elevations would be reduced in 41 months of the corresponding 490-month period of record, or about 8 percent of the winter months.

- In 24 of these 41 months, or about 4.9 percent of the total months in the winter recreation season, discernible reservoir water-surface elevation reductions of 10 or more feet would result.

- In 19 of these 41 months, or about 3.9 percent of the total months in the winter recreation season, demonstrably negative reservoir water-surface elevation reductions of 20 or more feet would occur under this alternative.

- In 15 of these 41 months, or about 3.1 percent of the total months in the winter recreation season, definitively negative water-surface elevation reductions of 30 or more feet would occur under this alternative.

Based on the modeled output for the 70-year period of record, the duration of elevation reductions of 10 or more feet could have extended for one 8-month period in water year 1984, two 5-month periods in water years 1951 and 1970, and one 4-month period in water year 1965. These periods equate to 22 of the 41 winter months in which such differences could have occurred. The remaining 19 months occurred in periods of three or less consecutive months.

The data reflecting the potential duration of visual resource impacts under the No-Action Alternative, therefore, support a very small probability (1 in 70, or 1.4 percent) that such elevation reductions would persist for longer than 8 months. There would only be a 2.8 percent probability that such elevation reductions would persist for more than 5 months.

Impacts to visual resources would, therefore, be short-lived. Although the No-Action Alternative would induce, at times, substantial demonstrable negative visual effects, those effects would be temporary and would disappear as the reservoir refills to levels that would have occurred in the absence of the project (probably in about 3 months or less). As a result, the No-Action Alternative would not result in the creation of an visually offensive site and would not permanently change the visual quality of the region, or permanently eliminate visual resources since the reservoir retains the capability to refill. Visual resource impacts are, therefore, found not to be significant.

<u>Shasta Reservoir</u>. Under the No-Action Alternative, visual resource values of Shasta Reservoir would remain subject to the same natural and operational regimes to which they are now subject. There would be no additional impacts to visual resource values.

<u>Summer Season Impacts</u>. The No-Action Alternative could negatively affect visual resource values of Shasta Reservoir if water-surface elevations in the reservoir were substantially lowered or the frequency or duration of low water-surface elevations substantially increased.

In most years, water-surface elevations during April through August would not differ between the No-Action Alternative and the Baseline. Water-surface elevations would be reduced by more than 1 foot in 32 months of the 350-month summer recreation period of record, with a maximum reduction of 7.3 feet. In all but 3 months during the summer period of record, water-surface elevations would change by less than 5 feet. Water-surface elevations were reduced by greater than 5 feet during June, July, and August of a single year, 1970. In no years would water-surface elevations be reduced by 10 feet or more. The infrequency and low magnitude of potential reductions in water-surface elevations in Shasta Reservoir during April through August does not constitute a significant adverse impact to visual resource values.

<u>Winter Season Impacts</u>. Water-surface elevations were reduced more frequently during the winter (September through March) than during the summer. However, as with the summer season, water-surface elevations under the No-Action Alternative would not differ from the Baseline in most years. Reductions in water-surface elevations of greater than 1 foot would occur in 64 months of the 490-month period of record for the winter season. In one winter season (September 1970 through November 1971), however, water-surface elevations were reduced by greater than 5 feet, but in no years were reductions in water-surface elevation greater than 10 feet.

<u>Clair Engle Reservoir</u>. Under the No-Action Condition, visual resource values of Clair Engle Reservoir would remain subject to the same natural and operational regimes to which they have been subject under the Baseline.

<u>Summer Season Impacts</u>. In most years, water-surface elevations in Clair Engle Reservoir during the summer season (April through August) would not differ between the No-Action Alternative and the Baseline. In only 9 months out of 350 months of the 70-year period of record for summer months would water-surface elevations be reduced by greater than 1 foot. In August 1985, the maximum reduction was 2.5 feet.

<u>Winter Season Impacts</u>. In most years, water-surface elevations in Clair Engle Reservoir during September through March would not differ between the No-Action Alternative and the Baseline. In only 20 months out of 490 months of the 70-year period of record for the winter season would water-surface elevations be reduced by greater than 1 foot. In October 1986, the maximum reduction was 2.9 feet.

Mitigation

Continued reoperation would have significant impacts to aesthetic values at the lake in the form of an expanded "bathtub ring" around Folsom Reservoir.

COMPARISON OF FOLSOM MODIFICATION PLAN TO BASELINE

Reoperation of Folsom Reservoir using the 475,000 to 720,000 acre-foot flexible storage diagram would not result in significant impacts to most of the resources listed above when compared to the No-Action Plan. When compared to the baseline condition, the resources listed below would have significant adverse impacts. The impacts and mitigation are discussed below.

WATER SUPPLY

CVP/SWP Deliveries

Impacts. Reoperation to 475,000/720,000 would reduce water supplies systemwide by about 19,000 acre-feet a year.

Mitigation. Mitigation for the reduction in water supply would be similar to that for the No-Action Alternative; that is, reduce demand on reservoirs when reoperation reduces supplies. This program would cost about $9.1 million a year.

Local Water Supply

Impact. Reoperation would occasionally lower Folsom Reservoir water surface, requiring more pump energy. In rare years, such as 1976 and 1977, local supply could be reduced by up to 20 percent (if not mitigated).

Mitigation. Local pumping agencies would be reimbursed for the anticipated additional energy need for pumping. Pump modifications could be made to increase efficiency as well. The cost for the pump energy is estimated at $40,000 per year. Reduced water supply in unusual years would be mitigated by the CVP water replacement mitigation plan. Folsom Reservoir levels would be restored to prereoperation levels by the end of the water year by reducing water demands. This should preclude local water supply reductions from reoperation.

Hydropower

Impacts. Reoperation would reduce hydropower production.

Mitigation. Mitigation for the reduction in hydropower would be similar to that for the No-Action Alternative, reimbursement to WAPA. The cost would be about $2.5 million a year.

RECREATION

Impacts. Reoperation under this plan would cause potentially significant impacts to off-season recreation at Folsom Reservoir as a result of low availability of boat launching facilities.

Mitigation. This impact could be mitigated to a less than significant level by modifying or extending low water boat ramps at Granite Bay, Hobie Cove, Brown's Ravine Marina, and Dike 8.

FISHERIES

Impacts

Reoperation under the Folsom Modification Plan would potentially cause significant redd stranding impacts on chinook salmon and steelhead in the lower American River. In addition, the Folsom Modification Plan could result in the significant cumulative impact of increasing the frequency-of-flow reductions during chinook salmon and steelhead trout spawning and incubation periods.

Mitigation

Redd stranding impacts can be reduced by decreasing the rate at which flows are reduced during the chinook salmon and steelhead trout spawning and incubation periods. The impacts to the frequency-of-flow reductions may not be mitigable considering the inflexibility of seasonal flood control criteria under the Folsom Modification Plan.

CUMULATIVE IMPACT SUMMARY

The American River Watershed Project report examines three major alternative courses of action, each having several individual components, which could be implemented to improve flood protection for the greater Sacramento metropolitan area, which is in the American River flood plain. Many other alternative flood control actions or component activities with potential to contribute to solving the problem were found infeasible or not cost effective. The No-Action Alternative is also discussed and represents the most likely "default" course of action in the event that none of the action alternatives becomes authorized.

Comprehensive evaluation of the cumulative impacts of each alternative is difficult because of their complexity and the large diversity of potential ramifications. To keep the discussion of cumulative impacts of this project pertinent, it was necessary to limit evaluations to related or similar projects occurring in the local region.

The Folsom Modification and Stepped Release Plans would not significantly increase the cumulative effects on CVP and SWP operations identified in connection with the No-Action Alternative. Other cumulative impacts of major concern are those related to the potential losses of riparian and wetland resources throughout the local region due to other flood control projects that are planned or under way to repair and upgrade the Sacramento River Flood Control Project or address other local regional flooding problems.

Cumulatively, the other various flood control projects will have the beneficial effect of raising the level of flood protection provided to lands in the local Sacramento Valley region, thereby reducing the risk of adverse impacts related to flooding. At the same time, however, these projects could reduce the small remaining wetland and riparian ecosystems along the rivers and streams where construction would take place. These impacts are generally mitigated, resulting in no net loss of riparian and wetland values, but causing temporary losses and probable changes in the specific types, quantities, and locations of these habitats.

The potential regional cumulative impacts of the various alternatives were portrayed by describing the current status of other projects along the Sacramento River and its tributaries and bypasses in the nearby region which could produce construction impacts similar to those of the Folsom Modification and Stepped Release Plans along the lower American River. Following is a summary of the main ways that each alternative will potentially result in cumulative impacts in association with similar or related projects that are ongoing or planned in the local regional area.

NO-ACTION ALTERNATIVE

Cumulative impacts would occur with the No-Action Alternative if it is assumed that reoperation of Folsom Reservoir becomes permanent according to the 1993 Diagram. These impacts include minor regional changes due to decreases of stored water and production of hydropower at Folsom that are linked to larger projects such as the Central Valley Project and State Water Project. In addition, there would be relatively greater cumulative impacts to local resources such as water supply and water-oriented recreation at Folsom Lake.

Other local resources at Folsom Lake and downstream in the lower American River, such as fisheries, riparian vegetation and wildlife, water quality, and cultural and visual resources, would be affected somewhat by implementation of permanent reoperation. However, average annual impacts are projected to be minor overall; over the long-term, they will be within a few percent of existing production levels. Production of some local resources that are dependent on seasonal availability of water would be less, but this is also

true in the baseline situation, as evidenced during the 1987-92 drought.

The cumulative impacts of concern under the No-Action Alternative are those associated with CVP/SWP operations. The model studies conducted in connection with this alternative incorporate anticipated future actions which could affect reasonably foreseeable demand for increased consumptive water use based on projections through the year 2020 and for environmental purposes based on changes in Delta water-quality and flow standards. When compared to the systemwide demands for CVP/SWP water, the impacts of permanent reoperation are considered to be very small. However, the studies do not account for CVPIA because of the uncertainties associated with the timing and manner of implementation, nor do they address the impacts on CVP storage of increased upstream diversions combined with higher instream flow requirements in the lower American River. In this regard, Folsom reoperation does reduce CVP carryover storage and lessen Reclamation's flexibility to respond to demands placed on the overall system.

On a regional basis, it appears that in the near-term the cumulative impacts of losses of most local resources at Folsom Lake associated with the No-Action Alternative will be insignificant because there is enough flexibility available in operations of linked facilities to compensate for shortfalls. The greatest concern is with regard to projected future deficiencies of water, hydropower, etc., over a long-term planning horizon greater than 25-years. In the meantime, it appears that, cumulatively, minor losses of production of these resources is easily a worthwhile tradeoff for increasing the level of flood protection to at least 100 years for the American River flood plain.

FOLSOM MODIFICATION PLAN

Potential cumulative adverse impacts of the Folsom Modification Plan are greater than the No-Action Alternative because the plan includes constructing improvements to Folsom Dam, the lower American River levees, and the east levee of the Sacramento River protecting the Natomas area, as well as an increased level of Folsom reoperation for flood management. Regionally, the extent of riparian and wetlands habitats cumulatively affected by construction of flood control projects in the foreseeable future are potentially greater than the No-Action Alternative, although they will be largely or completely offset by mitigation over the long term.

As with the No-Action Alternative, local resources produced at Folsom Lake that would probably be significantly affected by reoperations include water supply, hydropower, cultural resources, and recreation. There will be more years when the requirement to maintain lower water levels will result in less Folsom Lake recreation, water supply, and power production. Locally, cumulative impacts from losses of these resources will be greatest whenever a series of consecutive low rainfall years are consecutive, comparable to the 1987-92 drought. Regionally, cumulative impacts to these resources may be considerable in some years, but probably would not be of sufficient magnitude to be called significant overall, because of the availability of alternative recreation areas and water and power

supplies from other lakes that are either privately owned or part of the CVP and SWP systems.

Locally significant adverse cumulative impacts of increased reoperations associated with the Folsom Modification Plan include affects to Folsom Lake recreation and to downstream fisheries and aquatic resources. These effects are primarily associated with the potential for decreased seasonal boat access to the lake, and for the possible stranding of salmon and steelhead redds below Nimbus Dam in some years. It is thought that boat ramp extensions could mitigate Folsom Lake recreation impacts to less than significance, but it may not be possible to mitigate for redd stranding in some years because the increased fall drawdown required would deplete the available supply of water of suitable temperatures in the late fall-early winter season.

The Folsom Modification Plan would not increase the cumulative effects on CVP operations identified in connection with the No-Action Alternative. Accordingly, for purposes of this analysis, cumulative impacts were assessed by listing the projects which could produce impacts similar to the construction impacts produced by the Folsom Modification Plan along the lower American and Sacramento Rivers and their tributaries. The impacts of concern are those related to the loss of riparian and wetland resources over time.

STEPPED RELEASE PLAN

Potential cumulative adverse impacts of constructing facilities necessary for the Stepped Release Plan are locally and regionally even more significant than the Folsom Modification Plan because more areas will be built on and a higher floodway design capacity is specified. However, detailed projections of impacts to resources such as fish and wildlife habitat and recreation show that mitigation measures could be implemented which would largely or completely offset potential losses.

It appears likely that construction and mitigations proposed for the Stepped Release Plan, when evaluated locally and regionally over the long term, will result in minor net cumulative impacts for most resources. Resources such as fish and wildlife habitat will be affected somewhat during construction, but should recover to comparable levels regionally over the long term as a result of mitigation measures. Improved and new outdoor recreation facilities in the lower American River floodway will result in beneficial cumulative impacts regionally and over time.

Cumulative adverse impacts associated with long-term operations of the Stepped Release Plan will be minor for resources of concern. Proposed Folsom Lake reoperations would be the same as discussed previously for the No-Action Alternative. Rarely, during unusual flood events exceeding about a 100-year frequency of occurrence, it will be necessary to increase the amount of the objective releases into the lower American River. However, the various levees and riverbanks would be rebuilt to handle greater floodflows,

resulting in no increased loss of wildlife or fisheries habitat, recreation facilities, or roads or utilities when compared to the baseline situation. On average, as with the No-Action Alternative, cumulative losses of recreation, water, and power production at Folsom Lake can be compensated fairly well by integrating reoperations with existing regional production.

DETENTION DAM PLAN

Potential cumulative impacts of the Detention Dam Plan include the effects of periodic inundation on canyon ecology and the additive effect of construction of another dam on the western slope of the Sierra Nevada.

The periodic inundation within the upper American River has potential to cause vegetation mortality, soil losses, and physical damage to roads, trails, and other recreational facilities cumulatively over time. This would cause losses of wildlife and fisheries habitat values and recreational capabilities and the visual resource quality for existing uses such as whitewater rafting, hiking, and nature appreciation. However, the conditions of inundation are projected to ameliorate impacts to these resources; that is, because inundation would be of fairly short duration (less than 28 days for all areas) and would occur during the winter dormant season when plants are least likely to be affected.

Regionally, considering the number of major dams and reservoirs that have been built on similar rivers on the western slope of the Sierra Nevada at this elevation, there are potentially significant cumulative impacts associated with building another dam. There are not that many undammed rivers left in the western Sierra. However, because the proposed dam would be operated for temporary flood detention rather than permanent water impoundment, as described above and in chapter 9, it is not thought that this kind of dam operation will impact vegetation, various recreational uses, or other resource values nearly as much as operation of a permanent reservoir.

The following analysis identifies and describes the projects being undertaken to repair and upgrade the Sacramento River Flood Control Project and address local flooding problems. Cumulatively, these projects would have the beneficial effect of raising the level of flood protection provided to lands in the Sacramento Valley, thereby reducing the risk of adverse impacts related to flooding. At the same time, however, these projects could reduce the small remaining wetland and riparian ecosystems found along the rivers and streams where construction would take place. These impacts are generally mitigated, resulting in no net loss of riparian and wetland values, but resulting in changes in the specific types, quantities, and locations of these habitats.

Construction of the flood detention dam as proposed under the Detention Dam Plan would require relocating Highway 49. The impacts of this relocation along any one of the four alignments currently being contemplated will be evaluated on a programmatic basis to determine whether these impacts would be cumulatively significant when added to the impacts resulting from constructing the flood detention dam.

SACRAMENTO RIVER FLOOD CONTROL PROJECT

The Central Valley of California is 450 miles long and 40 miles wide and drains approximately 57,000 square miles. The Sacramento Valley occupies the northern half of this drainage and drains approximately 27,000 square miles of basin. Before valley lands were reclaimed for agricultural development, a large part of the Sacramento Valley, including the delta lands south of Sacramento and the basin lands between the river and the uplands, were subject to annual or periodic overflow. The potential flood plain, irregular in outline, varied in width from about 2 to 30 miles and extended 250 miles from Red Bluff to the mouth of the Sacramento River, and comprised an area of over 1 million acres.

The flood control system along the Sacramento River and its tributaries has evolved since the mid-1800's when levees were first constructed to control seasonal flooding. As described in chapter 4, the present system consists of the network of dams, levees, weirs, and bypasses which collectively comprise the Sacramento River Flood Control Project.

Although riparian vegetation was directly affected by the construction of the project, losses of this habitat were largely unmitigated because at that time there were no provisions in the project authorizations requiring either an environmental impact analysis or mitigation. Also, riparian vegetation was indirectly affected due to an increase in private development as a result of increased flood control. These impacts were also unmitigated. However, positive socioeconomic benefits have accrued due to greatly reduced flood damages.

Various studies of the historical and present extent of riparian vegetation along the Sacramento River and tributaries agree that less than 2 to 3 percent of historical woody riparian habitat area remains. It is assumed that cumulative effects on wildlife, fisheries, and plant species dependent on riparian habitats (terrestrial and aquatic) are directly correlated with the reductions in natural riverbank and riparian vegetation. Given the importance and value of this vegetation to wildlife and fisheries and the reduction to date, any further reduction must be considered a significant adverse impact.

As a result of the 1986 flood, various problems, including levee instability and lack of system capacity, were identified within this integrated flood control system. Accordingly, the Corps has initiated various investigations to identify and address these problems. These studies are listed below and their interrelationships are described.

SACRAMENTO RIVER FLOOD CONTROL SYSTEM EVALUATION

This study has reexamined the integrity of the Sacramento River Flood Control Project based on the events of the 1986 flood. The system includes 980 miles of levees and is designed to provide varying degrees of flood protection to lands adjacent to the Sacramento River from Chico Landing near Red Bluff south to Collinsville in the Sacramento-San Joaquin Delta, and the lower reaches of several tributaries including the American River. The study will determine if the system is functioning as designed or if remedial work is required to restore levees to their previously established design and

functions. Many of the project levees were built in the late 1800's and early 1900's by landowners and local reclamation districts. These levees were later improved and incorporated into the Sacramento River Flood Control Project by 1960. Because of the size and complexity of this system, the reevaluation was conducted in five phases.

Phase 1 consists of the Sacramento Urban Area Levee Reconstruction Project, which was designed to stabilize the east and west levees of the Sacramento River protecting Natomas, the Greenhaven-Pocket area of the City of Sacramento, and the City of West Sacramento. These levees were too porous in some areas to meet design specifications. This problem has been corrected by inserting a bentonite and soil seepage wall to form an impervious core in the east levee between Freeport and the I-5 crossing and the west levee below the Sacramento-American River confluence. The east levee above the I-5 crossing has been stabilized through the placement of a new berm along the landside toe of the levee. Construction began in August 1990 and was completed in 1994.

The levees have been strengthened but not raised beyond their original design elevation; therefore, no indirect impacts due to increased development were incurred. Construction took take place on the landward side of the levees, thereby minimizing environmental impacts. However, 70 acres of upland/riparian vegetation and 44 acres of open water/emergent marsh was removed or covered by construction. These losses were fully mitigated by acquiring and developing a 114-acre mitigation site south of I-5 and west of the river, creating a small lake, and planting the area with native wetland and riparian species (including elderberry shrubs). Details on the environmental analysis can be found in the Finding of No Significant Impact/Negative Declaration for the "Sacramento Urban Area Levee Reconstruction Project, Sacramento, California," completed in July 1990.

Phase 2 focuses on the levee systems along the Feather and Yuba Rivers in the Cities of Marysville and Yuba City. The initial appraisal report for this phase identified work consisting of raising 10.7 miles of levees to their authorized height and providing 19.5 miles of toe drains for levee stabilization. This project is currently entering the construction phase.

Phase 3 focuses on the mid-valley area between Sacramento, Marysville-Yuba City, and the Yolo Bypass from Fremont Weir to south of Putah Creek. The initial appraisal of the levees was completed in 1990. Recommended work includes 22.3 miles of levee raising, 4.9 miles of stabilizing berms, and 9.1 miles of seepage wall.

Phase 4 focuses on the levees in the Delta from Sacramento through Collinsville. Phase 5 concentrates on the levees of the upper Sacramento River north to Chico Landing. Initial appraisal reports for phases 4 and 5 have been completed.

The improvements identified in phases 2 through 5 may result in unavoidable losses of wildlife habitat. Mitigation for this construction-related impact will likely consist of management of project lands to compensate for the lost habitat values. A programmatic EIS for the "Sacramento River Flood Control System Evaluation, Phases II-V" was completed in

December 1991. Further environmental documentation will be completed for each phase as plans are finalized and after systemwide economic analyses are completed.

WEST SACRAMENTO PROJECT

This study examines ways to increase flood protection for portions of Southport and the City of West Sacramento. The study includes developed areas along the Sacramento River and Yolo Bypass from the Fremont Weir downstream to an area just south of Freeport. The draft feasibility study was completed in September 1991. The detention dam plan calls for raising the south levee of the Sacramento Bypass and the east levee of the Yolo Bypass below the Sacramento Bypass. This project would provide more than 400-year protection to the City of West Sacramento.

A total of 38 acres will be directly affected: 11 acres of wetlands and 27 acres of uplands. These acres would be fully mitigated through the acquisition and development of a 52.5-acre mitigation site. The tentatively selected mitigation site is adjacent to the Sacramento River Deep Water Ship Channel, south of the project area. Details of the impact analysis and mitigation plan can be found in the Feasibility Report and Environmental Impact Statement/Report for the Sacramento Metropolitan Area, California, which was made available in February 1992.

CACHE CREEK SETTLING BASIN RECONSTRUCTION PROJECT

This project raised the settling basin levees and weir to again trap the large volume of sediment flowing down Cache Creek before the creek enters the Yolo Bypass. By retaining the sediment in the settling basin, the capacity and effectiveness of the Yolo Bypass to provide flood protection are maintained. Construction began in late 1990, and has been completed. Coordination with interested agencies has confirmed that no adverse environmental impacts are expected; therefore, no mitigation plan was developed.

SACRAMENTO RIVER BANK PROTECTION PROJECT

This project is a long-term program that allows the Corps to use erosion control and setback levees to maintain the integrity of the Sacramento River Flood Control Project. Erosion control includes various forms of bank protection, but primarily consists of placing rock riprap to protect the levees. Setback levees involve moving existing levees farther from the river. The project area encompasses the 980 miles of levees along the east and west banks of the Sacramento River from Collinsville to Chico Landing; tributaries such as Steamboat Slough; and along the Feather, Bear, Yuba, and American Rivers; Sutter and Yolo Bypass; and smaller tributary streams.

First Phase

Construction, consisting of 430,000 linear feet of levee riprapping, was completed from 1960 to 1975 between Collinsville (river mile 0) and the ends of the project levees (river mile 176 east bank and river mile 184 west bank). Some revetment was also placed on sloughs in the Sacramento Delta below river mile 40 and on lower tributaries such as the American, Bear, and Feather Rivers.

At the time of construction, no provisions within the project authorization required mitigation. Initially, construction activities were conducted to minimize impacts to the extent possible, and in 1986 the Corps was authorized to provide mitigation to compensate for habitat affected during the first phase of construction.

Subsequent to construction, the U.S. Fish and Wildlife Service prepared a report entitled "Fish and Wildlife Management Plan for Sacramento River Bank Protection Project, California" which listed project impacts as follows: loss of 180 acres of riparian habitat; alteration of 456 acres of riparian habitat due to construction; loss of 3,700 acres of agricultural land adjacent to construction; loss of 80 miles of streambank habitat for aquatic mammals and fish; and unquantified habitat losses for several endangered or rare species. The FWS concluded that acquisition and replanting of 668 acres of riparian vegetation were required to mitigate for first-phase impacts. Following a comparative analysis of without-project and with-project conditions, the Corps, although supporting the concept of providing the 668 acres, identified only 260 acres which were justified as mitigation. The remaining 408 acres were classified as enhancement, since they existed in areas where Federal and State regulations required vegetation removal under normal maintenance of the levee system.

With close cooperation of the FWS and The Nature Conservancy, acquisition of and riparian vegetation plantings on the 260-acre linear riparian vegetation recovery corridor as initiated in 1990 and remains under way and is scheduled for completion in 2001. The first parcel of 100 acres near river mile 192.4 was purchased by The Nature Conservancy and was planted in the spring of 1991; the project completion date is 1997, including the 3-year maintenance period.

Second Phase

The second phase of the project was authorized in 1974 and allowed for construction of 405,000 linear feet of bank protection work within the Sacramento River and its sloughs and tributaries. This act also provided that an estimated 10 percent of total construction costs be spent on measures to mitigate adverse environmental impacts.

About 320,000 linear feet was constructed or under construction on August 4, 1989, when the emergency rule of the National Marine Fisheries Service (NMFS) listing the winter-run chinook salmon as a threatened species was published in the Federal Register. At that time, further construction was delayed pending the outcome of State and Federal endangered species consultations.

Part 1 of the Sacramento River Bank Protection Project Second Phase provided approximately 180,000 linear feet of rock revetment. Although a specific acreage target was not developed by the FWS for environmental mitigation within Second Phase Part 1, the resource agencies recommended that 10 percent of construction costs be spent (1) to protect as many acres of riparian vegetation as possible using Right 8 easements or (2) to save as many trees as possible using rockfill instead of bank cutting in preparing the revetment slope. As a result of these measures, 77 acres of berm was protected by rockfill, and 231 acres of easement was acquired.

An additional 225,000 linear feet of bank protection is proposed for Part 2 of the second phase of the bank protection project. The first contracts within the Second Phase Part 2 followed the outline of Part 1, 10 percent construction costs to be spent for providing easements and rockfill as mitigation techniques. Subsequent contracts provide mitigation on the basis of habitat-based analysis and provide for mitigative features including fish groins; experimental bank swallow habitat; riparian vegetation replanting; construction of berms or dredged berms; acquisition of easements or fee title; and the development of wetland habitats. To date, over 250 acres have been acquired as easements, and approximately 70 acres have been purchased in fee.

Third Phase

This project is currently in the planning phase and has not been authorized for construction.

YUBA RIVER BASIN INVESTIGATION

The reconnaissance study was completed in March 1990. Of the proposed alternatives investigated in the reconnaissance study, levee raising along the Feather and Yuba Rivers to provide at least a 150-year level of flood protection was found to be feasible. Detailed feasibility-level studies were initiated in September 1991. A draft feasibility report and EIS are expected to be completed in late 1997. Levee raising, if authorized, would take place primarily on the landward side of the levees, affecting primarily agricultural and grassland habitats. Detailed environmental analysis and mitigation studies will be conducted for the EIS.

These enhancements would provide the Yuba River study area with protection above the current design of the system. As a result, floodwaters which might otherwise cause levee failure and extensive flooding in the study area will be contained within the system and conveyed downstream. To the extent that these downstream flows would compromise the integrity of the existing system below the study area, these adverse hydraulic impacts would have to be addressed to determine if mitigation would be required as part of the project.

For example, it is currently believed that the Sacramento metropolitan area could withstand a 200-year storm on the Sacramento River because projected levee failures in the

Yuba and Feather River area would allow massive volumes of floodwater to leave the system, thereby reducing the stage of the flood at the Sacramento-Feather River confluence and allowing the peak flow of the storm to pass by Sacramento without any levee failure. (See discussion in appendix K, Hydrology, of the 1991 ARWI report). If the levee work contemplated as part of the Yuba River Basin Investigation results in 200-year flows being contained within the system, then these flows could raise the stage of the flood at the Sacramento-Feather River confluence enough to cause levee failure along a portion of the system protecting metropolitan Sacramento.

LOCAL TRIBUTARY PROJECTS

Portions of the Sacramento urban area are subject to flooding not only from the Sacramento and American River channels, but also from a series of tributary streams which form their own distinct flood plains. The three principal streams of concern in this regard are (1) the Morrison Creek Stream Group, which threatens portions of south Sacramento; (2) Magpie Creek, which is capable of flooding areas of north Sacramento; and (3) Dry Creek, which threatens the town of Rio Linda and the Cherry Island area of Sacramento County. To address these flood problems, a series of local tributary projects is contemplated.

South Sacramento Urban Levees and Tributaries Project

The South Sacramento Urban Levees and Tributaries project would provide increased flood protection to people and property subject to flooding from the Morrison Creek Stream Group. This group of waterways includes Morrison, Laguna, Unionhouse, and Elder Creeks. Morrison Creek drains an area of about 100 square miles upstream from its confluence with Laguna Creek. The creek has an extensive flood plain both upstream and downstream from this confluence. The creek is confined by levees and occupies a broad floodway as it flows through the bufferlands surrounding the Sacramento Regional Wastewater Treatment Plant. Morrison Creek then flows south into Beach, North Stone, and South Stone Lakes before entering the Sacramento-San Joaquin Delta through Snodgrass Slough and the Mokelumne River. Morrison Creek flows year-round and supports riparian vegetation, wildlife, and a warmwater fishery.

Laguna Creek drains an area of 47 square miles above its confluence with Morrison Creek in the bufferlands around the wastewater treatment plant.

Elder Creek runs generally parallel to the upper reaches of Morrison Creek. Elder Creek is tributary to Morrison Creek in its lower reaches. Much of the Morrison Creek flood plain is at a lower elevation than the Sacramento River. Two pump stations remove floodflows and summer low flows from the flood plain and discharge them to the Sacramento River. This prevents excessive buildup of floodwaters and also allows seasonal agricultural use of the flood plain lands.

Continued development in areas drained by the stream group may exacerbate existing flood problems in urbanized portions of the stream group flood plain, including much of southwest Sacramento and the Pocket area of the City. The City and County of Sacramento are negotiating a Memorandum of Agreement that would encourage new development in the flood plain to control runoff and eliminate further worsening of flood problems in the future. The city envisions three projects to increase the level of flood protection to property in these areas from existing flooding conditions:

- Immediate Urban Levees Project. This project would include stabilization and raising of the west/north Morrison Creek levees and would provide protection to southwest Sacramento and the Pocket area. This work will be done as maintenance of the existing levees on the landward side. Most of the work will be accomplished on top of existing levees or landside stabilizing berms.

- Elder and Unionhouse Creeks, California, Section 205. Under this project, channel and levee improvements would be made on Elder, Unionhouse, and lower Morrison Creeks with Corps, State, and local funding. The Corps is currently studying this project under its Section 205 continuing authorities program.

- Morrison Creek Stream Group, California. The City has also requested that a new general investigations study of the rest of the Morrison Creek Stream Group, including Elder, Unionhouse, Strawberry, and Florin Creeks, be conducted by the Corps under the Northern California Streams authority.

With these projects, raising or constructing levees and modifying channels to improve flow of floodwaters is anticipated. Exact areas of impact have not been identified. Some losses of riparian and wetland habitats will be inevitable in these types of projects. However, all three projects are being conducted in accordance with NEPA or CEQA guidelines and will seek to minimize impacts or fully mitigate unavoidable losses of habitat.

Magpie Creek Diversion Channel Improvement Project

This project would control flooding in the north Sacramento area of the city and portions of McClellan Air Force Base. Magpie and Don Julio Creeks are intermittent streams which originate east of McClellan in Sacramento County. Both Magpie and Don Julio Creeks originate north of I-80. The two creeks flow west through McClellan and presently join upstream from the Magpie Creek Diversion Channel. The combined flows are conveyed through the diversion channel to Robla Creek, which is tributary to Dry Creek, and thence into the NEMDC. On McClellan, a lateral canal between the two creeks permits some equalization of flows in the two creeks and forms a common flood plain.

Urban development in the watershed, including development and channelization within McClellan, has increased peak runoff and flood volume to Magpie Creek and the existing diversion channel, thereby increasing the flood hazard to the area. Increases in runoff are

due to the decrease in the amount of land available to store floodwater and to absorb rainfall and runoff resulting from urbanization.

The Corps has completed a reconnaissance-level report for Magpie Creek under the Section 205 authority and expects to complete a feasibility level study by the end of 1995. The potential plan for this area involves channel modifications and levee construction from the confluence of the existing Magpie Creek Diversion Channel and Robla Creek near Vinci Avenue. A new flood control channel would be constructed from that point to connect to Magpie Creek at Patrol Road on McClellan. Additional flow deflectors would be constructed on the levee.

Potential impacts include the loss and/or degradation of riparian and freshwater marsh, vegetation, grassland habitat, woody riparian habitat, and herbaceous riparian vegetation within the project area. These losses could affect roosting and nesting practices and breeding, feeding, and resting habitat for birds, small mammals, amphibians, and reptiles. However, vernal pools that lie near the proposed project area will be protected from impacts during channel and access road construction. In addition, the "Proposed Project" may affect cultural resources through disturbance of a cultural resource site during excavation. Mitigation for disturbed habitats would be provided by developed wildlife habitat on portions of McClellan.

Dry Creek Flood Control Project

This project would control flooding in the Dry Creek flood plain. The town of Rio Linda, as well as other areas along Dry Creek, is subject to frequent flooding because Dry Creek lacks adequate channel capacity to convey large floodflows. Hydrologic and hydraulic studies completed by the Corps have determined that Dry Creek is capable of carrying the runoff of about a 5-year frequency storm event. During the February 1986 flood, approximately 2,000 acres of the Dry Creek flood plain below the Sacramento County line experienced extensive flooding.

This flood problem is complicated by the fact that Dry Creek splits into two small branches above Rio Linda. When flows exceed the existing channel capacity, the total area between these branches becomes inundated. This area is referred to as Cherry Island. Numerous residential, commercial, and industrial structures are located in the Dry Creek flood plain along with several bridges and streets which become impassable during flooding. Thus, businesses and residences can be disrupted for up to several days and can be damaged. The reach of Dry Creek is subject to the most severe flood damages is about 3 miles long and extends from Marysville-Rio Linda Boulevard to north of Dry Creek Road.

SAFCA is investigating alternatives to provide adequate protection (100-year flood protection) to people and property in the Dry Creek flood plain. Based on preliminary engineering analysis and study, SAFCA developed a concept plan that includes a new leveed channel that bisects the existing flood plain which could protect the town of Rio Linda and its main transportation arteries (Elkhorn Boulevard and Dry Creek Road) from being inundated

during a 100-year flood. The new channel and levees would extend about 2 miles and would consist of an earthen trapezoidal channel with a bottom width of about 200 feet and an average depth of 15 feet. The levee would have a top width of 20 feet with side slopes of 2 to 1 on the landside and 3 to 1 on the waterside. The channel and levees would be located to avoid or minimize removal of any vegetation, particularly mature stands of trees. New bridges would be required at Dry Creek Road and Elkhorn Boulevard. Environmental clearance in accordance with CEQA will be obtained prior to construction.

NATOMAS AREA FLOOD CONTROL IMPROVEMENT PROJECT

The Natomas Area Flood Control Improvement Project was approved for construction with local funding by the Sacramento Area Flood Control Agency in June 1993. The project, referred to herein as the "Approved Local Project," is designed to provide the Natomas Basin with more than a 100-year level of flood protection independent of any improvement in flood control capability along the American River upstream of Natomas. The Approved Local Project would also protect portions of the North Sacramento, Rio Linda, and Elverta communities by controlling high flows in the lower Dry and Arcade Creek watersheds and by reducing flood stages in the Natomas East Main Drainage Canal (NEMDC) north of Dry Creek.

Elements of the Approved Local Project, which have been modified as the project planning process has moved through the final design stage and into construction, are described below.

Natomas East Main Drainage Canal

Raise portions of the east and west levees a maximum of 3.5 feet. The west levee raise would extend from the pump station north of Dry Creek to approximately 1,700 feet south of West El Camino, and the east levee raise would extend from the existing Robla Creek levee to approximately 2,000 feet south of West El Camino. Construct stoplog structures would be constructed at the east and west ends of the El Camino Avenue bridge crossing of the NEMDC.

Main Avenue Bridge

Construct a temporary stoplog structure at West Main Avenue until funding is available to construct a new four-lane high-level bridge across the NEMDC and Union Pacific Railroad.

NEMDC Pumping Plant

Construct a large pump station and gated control structure across the NEMDC near the mouth of Dry Creek. The structure housing the pumps will be 30 feet high and provide approximately 10,000 square feet to accommodate three 333-cfs diesel pumps.

Arcade Creek

Raise the north levee between the NEMDC and Marysville Boulevard a maximum of 2 feet to match the top elevation on the south levee and ensure low points are not left in upstream reaches. Using a combination of earthfill and floodwall, raise the south levee west of Marysville Boulevard a maximum of 3 feet for a 500-foot reach. Construct stoplog structures at the north and south ends of the Norwood Avenue bridge crossing of Arcade Creek and at Rio Linda Boulevard, or tie the levee or floodwall at Rio Linda Boulevard into the existing concrete bridge rail.

Dry\Robla Creek

Construct a new levee with a maximum levee height of 12.5 feet extending from the pump station along the Union Pacific Railroad, Ascot Avenue and 4th Street to high ground east of Rio Linda Boulevard. Raise the existing south Dry\Robla Creek levee a maximum of 8 feet across Rio Linda Boulevard north of Claire Avenue. Rebuild Rio Linda Boulevard along the top of the proposed levee and extend the existing levee east of Rio Linda Boulevard to the confluence of Robla Creek and the Magpie Creek Diversion Channel at a maximum height of 11 feet.

Pleasant Grove Improvements

Raise the Pleasant Grove Creek Canal (PGCC) west levee and Howsley Road by 1.5 feet to fill low spot in the levee. Construct a stoplog structure and retaining wall at the west end of the Fifield Road Bridge leaving the existing bridge unmodified. Reinforce the PGCC levee where the levee intersects Sankey Road.

When funding permits, raise the PGCC levee approximately 5 feet where the levee intersects Sankey Road and implement the following measures to create a detention storage basin covering approximately 1,000 acres of farmland east of the PGCC and west of the UPRR (Union Pacific Railroad) between Howsley and Sankey Roads. Construct a new levee along the north side of Sankey Road across the UPRR to the intersection of Pleasant Grove Road. Install three closure structures in the Sankey Road levee at the UPRR crossing and at farmstead access roads east and west of the UPRR. Install culverts with flap gates on the southerly end through the levee and under Sankey Road and extend the existing NEMDC channel to receive floodwaters discharged through the culverts. Construct a levee along the south side of Howsley Road from the bridge at the PGCC east to the UPRR and install 10 culverts with flap gates through the levee to receive floodwaters from lands to the north. Breach existing wing levees west of the UPRR at Pleasant Grove Creek, Curry Creek Pierce Roberts Drain to the minimum extent required for inundation of the detention basin. Remove the abandoned Sacramento Northern Railroad embankment south of Howsley Road to a point just north of Sankey Road.

Natomas Cross Canal

Raise the existing south levee east of the Garden Highway to approximately State Highway Route 99.

American River North Levee

Raise a 200-foot reach of the American River north levee (the Garden Highway) between 0.0 and 0.5 feet by means of building up the existing asphalt pavement. Construct a stoplog structure on the north side of the Northgate Boulevard NEMDC bridge approach. Construct additional stoplogs at the UPRR track west of Del Paso Boulevard.

SIGNIFICANT ACTIONS SINCE 1992

The following actions subsequent to the 1992 legislative session have affected the scope and nature of the Corps' response to Congress' call for a reevaluation of the American River project: (1) SAFCA's start of construction of the Natomas features of the project with local funds (SAFCA Local Project); (2) execution of a 5-year agreement between SAFCA and Reclamation to modify the operation of Folsom Reservoir (Interim Reoperation); (3) initiation of a bank protection project affecting up to 9,100 lineal feet along critical reaches of the lower American River under the authority of the Sacramento River Bank Protection Project (Lower American River Bank Protection Project); and (4) initiation of a regional water study, the American River Water Resources Investigation by Reclamation in conjunction with Sacramento, Placer, El Dorado, and San Joaquin Counties; and Wild ad Scenic Rivers and National Recreation Areas eligibility studies. These actions and their effect on the Corps plan formulation process are discussed below.

SAFCA Local Project

This project, which was described in more detail in the previous section, received a Department of the Army permit in June 1993 and will provide the Natomas basin and portions of the lower Dry and Arcade Creek watersheds with 100-year or greater flood protection. The project is designed to accommodate flows in the lower American River up to 180,000 cfs and is thus compatible with all the main stem American River alternatives being evaluated in connection with the ARWI. Nevertheless, the project does not depend on any upstream improvements to remove the protected areas, including the Natomas basin, from the regulatory flood plain. These project improvements and the direct and indirect (growth-inducing) impacts caused by the project are fully described in the Final Environmental Impact Report for the Revised Natomas Area Flood Control Improvement Project (Final EIR) and the supplemental environmental documents issued in connection with the Final EIR which are available through the SAFCA office at 926 J Street, Suite 424, Sacramento, California 95814.

Interim Reoperation

This project was implemented by agreement between SAFCA and Reclamation in February 1995. The implementing agreement requires Reclamation to operate Folsom Reservoir during the flood season in accordance with a flood control diagram (1993 Diagram) designed to reduce the probability of flooding by levee failure to a 1 in 100 chance in any year. The 1993 Diagram ties Folsom Reservoir storage to storage in the three largest non-Federal reservoirs in the American River watershed: Union Valley, Hell Hole, and French Meadows. When these reservoirs have between them at least 200,000 acre-feet of space available for flood storage, Folsom may store up to 575,000 acre-feet of water, reserving at least 400,000 acre-feet of empty space for flood storage as required under the Corps 1986 flood control diagram. When the upstream reservoirs fill so that less than 200,000 acre-feet of space is left for flood storage, Folsom Reservoir must be drawn down to compensate. When the upstream reservoirs are full and no space is available for flood storage, Folsom may store no more than 305,000 acre-feet of water, reserving 670,000 acre-feet for flood storage. To protect the environmental and recreational resources in the lower American River, the Interim Reoperation implementing agreement further obligates Reclamation to ensure that Folsom Reservoir releases during the spring refill period are at least equal to the lesser of (1) the releases that would have been made if Folsom had continued to be operated in accordance with the 1986 Diagram or (2) the releases designated by Judge Hodge in deciding the matter of Environmental Defense Fund et al. versus East Bay Municipal Utility District (Hodge flows).

The implementing agreement obligates SAFCA to mitigate the potential adverse impacts of this changed operation. These impacts include reduced CVP water deliveries, reduced CVP power generation, increased power costs for local water agencies taking deliveries directly from Folsom Reservoir, reduced reservoir recreation opportunities, increased exposure of shoreline cultural resources to damage, and increased temperatures potentially harmful to the fishery in the lower American River. The agreement anticipates that this mitigation will generally take the form of annual payments for replacement of the lost or expended resources. However, SAFCA has undertaken two significant permanent improvements in connection with Interim Reoperation: (1) modification of the shutter system which controls the elevation (and therefore the temperature) of releases through the main dam and (2) boat ramp extensions in the Hobie Cove/Brown's Ravine area to permit access to the reservoir at the lowest water-surface elevations required under the 1993 Diagram.

Sacramento River Bank Protection Project, Lower American River

The Corps of Engineers and The Reclamation Board in cooperation with the Sacramento Area Flood Control Agency are proposing to construct streambank protection on the lower American River under the Federally authorized Sacramento River Bank Protection Project. The purpose of the streambank protection is to protect the integrity and reliability of Federal flood control levees, while preserving existing environmental values and the wild and scenic recreational status of the lower American River and parkway.

Bank protection is proposed under the currently authorized Sacramento River Bank Protection Project because (1) immediate actions are necessary at sites to reduce the threat of levee failure, (2) an existing authorized project can address these critical sites, and (3) bank protection is needed on the lower American River regardless of what alternative is selected by the American River Watershed Investigation.

Since January 1994, the Lower American River Task Force, composed of flood control agencies, resource protection agencies, and local interest groups, has been developing a locally-preferred erosion control plan for the lower American River which includes streambank protection measures to reduce the immediate and future risks of levee failure. The plan for managing bank erosion developed by consensus among the Task Force participants comprises immediately needed streambank protection at four critical sites comprising 9,100 linear feet of streambank and bank protection needed for the longer term. The immediate bank protection is proposed for construction in 1997. Longer term streambank protection may be needed at any location along the Federal levee system where levees become threatened by erosion. Potential sites have been identified (13 sites comprising 9,000 linear feet) that may become critical in the future. Other sites may be identified from future flood events.

The designs for streambank protection developed by the Task Force are intended to preserve and recreate as much aquatic and riparian habitat values and visual quality as feasible. Designs contain well-vegetated, visually irregular surfaces composed of rock, soil, and biotechnical materials. Large, woody material is proposed along the shoreline, and marsh and riparian vegetation would be established on the streambank protection structure.

A Supplemental Draft Environmental Impact Statement/Environmental Impact Report is scheduled to be distributed for public review and comment in the spring of 1996. This environmental document will assess the environmental effects of the Task Force's locally preferred streambank protection project and alternative plans.

American River Water Resources Investigation

The American River Water Resources Investigation (ARWRI) was initiated in the fall of 1991 under the authority of the American River Basin Development Act (Public Law 81-356). It is being organized by the Bureau of Reclamation. Federal funding is available on a year-to-year basis through the House Appropriations Committee, provided 50 percent matching funds are contributed in equal shares by the non-Federal sponsors of the study—the Sacramento Metropolitan Water Authority, the American River Authority, the San Joaquin Flood Control and Water Conservation District, and the Sacramento County Water Agency (in partnership with the City of Sacramento). The purpose of the investigation is to identify significant water resource needs within the American River study area, formulate alternative plans to meet those needs, and determine a preferred alternative. The study is particularly focused on (1) providing for forecasted water supply needs for municipal, industrial, and agricultural use; (2) providing instream flows sufficient for water-oriented recreation; (3) sustaining wildlife habitat and the ecosystem of the river; and (4) providing for unmet

flood control needs. The study is proceeding in four phases. Phase one consists of identifying water-related needs by examining existing systems. This phase was completed in February 1995. Phase two consists of plan formulation, analysis, evaluation, and identification of a preferred plan. Reclamation completed this phase in July 1995. Phase three, in which Reclamation will determine the feasibility of the preferred plan, prepare a Planning Report and Draft Environmental Impact Report/Draft Environmental Impact Statement, and circulate this document for public review and comment, is due for completion in January 1996. In Phase four, public comments will be addressed and a final report will be prepared by May 1996. This will then be submitted for a decision by Congress.

IMPACTS OF EXPANDING THE FLOOD DETENTION DAM TO A MULTIPURPOSE FACILITY

The Detention Dam Plan was formulated to neither promote nor prohibit expansion for permanent water storage at the Auburn site. Expansion to a multipurpose dam project with a permanent pool would significantly increase vegetative losses, geomorphological changes, and related impacts over those identified for the Detention Dam Plan.

A multipurpose project could be implemented in one of two possible ways: (1) construction of a multipurpose facility independent of flood control proposals on the American River (authorized and built instead of flood-control-only facilities or at a different location from the proposed flood detention dam) or (2) expansion of a flood-control-only dam sometime in the future. This section highlights the features required to expand a proposed flood control project to a multipurpose dam and summarizes the potential impacts of a large multipurpose dam under either method of authorization. This discussion draws heavily on the previous environmental work completed by Reclamation for the full-sized multipurpose Auburn Dam.

BACKGROUND

The Auburn-Folsom South Unit of the Central Valley Project was authorized in 1965 under Public Law 89-161 for construction by Reclamation. Included among its features were the Auburn Dam and Reservoir on the North Fork American River upstream from Folsom Reservoir. The dam, as originally proposed, would have impounded a reservoir with a gross pool storage of 2.3 million acre-feet, inundating over 10,000 acres, and providing benefits for water supply, hydropower, recreation, fish and wildlife, and flood control.

Construction of the dam was suspended in 1975 following a 5.7 Richter magnitude earthquake at Oroville, California. Although seismic studies indicated that the probability of a major earthquake (6.0 or greater) at the Auburn site was relatively low, and the planned double curvature, thin-arch design was believed capable of withstanding such an event should it occur, the design was replaced with a concrete gravity design. Construction was not

restarted because of changes in Federal policy on cost sharing and vigorous opposition from environmental groups. Under current cost sharing policy, the non-Federal project sponsor must pay, at the time the project is constructed, the cost of all hydropower and municipal and industrial water supply features.

ACTIONS REQUIRED TO EXPAND A FLOOD-CONTROL-ONLY DAM TO A MULTIPURPOSE FACILITY

Expansion of a flood detention dam into multipurpose facility providing water supply, power generation, and recreation in addition to flood control would likely require (1) additional engineering and environmental study and documentation; (2) significant physical modifications; (3) additional congressional authorization; and (4) identification of non-Federal cost-sharing partners.

Reconnaissance-level cost estimates of a 2.3 million acre-foot multipurpose dam are in excess of $1.7 billion. The expansion of the flood detention dam to a multipurpose facility would trigger a reallocation of costs among the project purposes. The reallocation would most likely be implemented using the principles of the Separable Costs-Remaining Benefits methodology.

The major physical modifications to the flood control facilities include:

- Additional foundation work and grouting.
- Additional concrete and related structural elements to raise and widen the dam to the desired crest elevation.
- Construction of outlet works.
- Construction of a generating plant and electrical transmission facilities.
- Reconstruction of the emergency spillway.
- Installation of regulatory gates on the spillway.
- Construction of recreational facilities.
- Acquisition of additional lands for the project features and mitigation.
- Implementation of a plan to mitigate impacts on environmental and related resources.

The Detention Dam Plan wold not alter the original authorization for Reclamation's Auburn Dam Project. For example, the Federal ownership of lands in the inundation zone would not be affected. All fee land required for the Detention Dam Plan (except those required for environmental mitigation) would be acquired by joint-use permits. The non-Federal sponsor will obtain flowage easements from the Federal landowners within the inundation zone. Any future disposition of lands would have no effect on the flood control project. Congress could then determine the disposition of those lands outside the inundation zone, independent of the flood control project. These lands could be retained for a future multipurpose dam or a Federal recreation area.

Under applicable Federal planning principles and guidelines as well as congressional policies, a multipurpose project could not proceed at the Auburn site without being redesigned, subjected to environmental review, and reauthorized by Congress. This would be true whether the redesigned project provided for converting or expanding the flood detention dam or for constructing a new dam in a different location. Since such review and reauthorization would be required even without a flood detention dam, implementation of the Detention Dam Plan would not impose any new procedural requirements on the multipurpose project or avoid any requirements which would otherwise apply (CEQA Guidelines, Section 1502.9).

ENVIRONMENTAL IMPACTS

This section discusses the impacts that would result from the expansion of a detention dam into a multipurpose project (assuming that design plans for such an expansion are completed and authorized by Congress). The discussion focuses primarily on the expected direct project impacts of the 2.3 million acre-foot reservoir analyzed by Reclamation. Smaller multipurpose reservoirs have been studied by Reclamation and DWR. However, consideration of the largest feasible structure would maximize impacts and, therefore, represent a worst-case scenario.

Fish and Wildlife

A 2.3 million acre-foot reservoir, with a maximum water-surface elevation of 1,135 feet, would permanently inundate over 10,000 acres of river canyon and 48 miles of mostly free-flowing stream. By comparison, the flood-control-only dam, with a maximum water-surface elevation of 942 feet above sea level, would temporarily inundate up to 4,000 acres of canyon and 36 miles of stream. The maximum inundation has less than a 1 in 500 chance of occurring in any year (table 10-1).

Mapping by FWS in 1989 showed that the predominant cover types within the respective flood storage pools of both the dry dam and multipurpose dam include north slope oak woodlands, south slope oak woodlands, chaparral, coniferous forest, grasslands rocky/ruderal, and riverine/riparian habitat.

Based on the total acres of each cover type inundated by the large reservoir it is estimated that the large reservoir would increase the loss of habitat within the north slope oak woodlands by 3,503 acres over the detention dam plan, increase the loss of south slope oak woodlands by 3,537 acres, increase the loss of chaparral by 591 acres, increase the loss of coniferous forest by 657 acres, and increase the loss of grasslands by 556 acres (table 10-1).

The flood detention reservoir would be expected intermittently to inundate approximately 40 miles of the North and Middle Forks of the American River during about a

400-year storm. The large reservoir would permanently impound 48 miles of stream. Notwithstanding Lake Clementine in the North Fork, the large reservoir would result in converting a free-flowing riverine fishery to a flat-water lake fishery. The flood detention reservoir would maintain existing stocks of warm and cold water species, such as rainbow

TABLE 10-1

Comparison of Habitat Losses Between Projects

	North Slope Oak Woodland	South Slope Oak Woodland	Chaparral	Coniferous Forest	Grassland	Montane Riverine	Total
Acreage Losses Attributable to Project Construction and Operation							
Multipurpose reservoir	4034	4068	653	729	757	NA*	10,241
Flood detention dam	435	627	62	72	313	136	1,645
Difference	3,599	3,441	591	657	444	136	8,868

[1]Modified from FWS, 1990
NA - Not available

trout, brown trout, smallmouth bass, Sacramento squawfish, and Sacramento sucker. The large reservoir would tend to favor sunfishes, largemouth bass, smallmouth bass, and catfish. However, species compositions and populations would be highly dependent on stocking programs implemented by DFG.

The multipurpose reservoir project could provide benefits to the regional fishery by dampening the water-level fluctuations in Folsom Reservoir and providing additional coldwater storage capacity to enhance natural production of steelhead trout and chinook salmon in the lower American River. The magnitude of these potential benefits would depend upon operating procedures and the amount of water storage allocated to these purposes.

Recreation

As described in previous sections, the estimated visitation in the upper American River canyons is approximately 500,000 persons annually. The flood detention dam is not expected to change the type, location, or quality of recreation in the upper American River basin, with the exception of visual resource impacts which are discussed in chapter 9. In addition, visitation is not expected to be significantly affected during flood operations because

such events would be infrequent, of relatively short duration, and would occur during off-peak season when visitation is less than 10 percent of annual use. Inclement weather would be associated with flood operations and would normally inhibit off-season visitation with or without an impounded flood pool.

In contrast, a large multipurpose reservoir would significantly alter recreation in the canyons. River-dependent or river-enhanced recreation would be replaced by reservoir-dependent recreation. Within the 48 miles of permanently inundated river channels, unique activities such as whitewater rafting and recreational gold mining would be eliminated. Because of the scarcity of whitewater rafting reaches in California, this would be considered a significant impact. Of the existing 72 miles of equestrian, hiking, and biking trails, 58 miles would be inundated. The Auburn Project General Plan calls for the development of 120 miles of riding and hiking trails. If constructed, the trails would generally be located a considerable distance from the lakeshore due to the steep canyon topography.

Approximately 100 existing primitive campsites would be lost due to inundation. However, park development plans indicate that these would be replaced with 280 developed campground sites, including 5 trail campgrounds and 6 boat-in campsites.

Stream fishing would be supplanted by reservoir fishing with a higher dependence on motorized boating, which would limit fishing opportunities to those with such boats.

A large permanent reservoir could provide additional opportunities for motorboating, sailboating, waterskiing, jetskiing, and other reservoir-dependent activities. The California Department of Parks and Recreation has projected that approximately 2,400 acres of the large reservoir would be reserved for nonpower boating and 3,400 acres would be reserved for waterskiing and powerboating; restricted speedboating would be allowed on 4,200 acres (BLM, 1990). The reservoir would have a design capacity for 117 boats in the ski zone and 145 boats in the restricted speed zones. However, the large multipurpose reservoir is expected to fluctuate by as much as 300 vertical feet during drawdown, which is expected to decrease the surface area of the lake to 4,000 acres and reduce boat capacity by 60 percent.

Reclamation anticipated that facilities would be provided at the large reservoir to accommodate 2 million visitor days annually and sufficient land to accommodate 5 million visitor days. The character of the recreation experience would change from wilderness/semiwilderness to developed recreation. The change would likely be considered a significant loss due to the scarcity of semiwilderness areas close to major metropolitan areas and easily accessible by major roadways. In contrast, several reservoirs within the basin and within reasonable driving distances provide recreation opportunities similar to those that would be provided by a large multipurpose reservoir.

A large reservoir could potentially enhance recreational experiences in Folsom Reservoir by stabilizing pool levels and in the lower American River by providing higher sustained releases. However, the magnitude of these potential beneficial effects would depend on specific operational procedures.

Water Quality

Construction of a permanent reservoir would result in short- and long-term changes in water quality. After initial filling, new reservoirs undergo several years of biological and chemical change resulting from the decomposition of flooded organic matter (Gunnison et al., 1986). Nutrients, such as phosphorus, nitrogen, and trace metals, enter the reservoir by four primary means: (1) leaching and physical separation from mixed soils and organic debris; (2) leachate and particulate matter from submerged terrestrial vegetation; (3) inflow from the drainage basin; and (4) drowned terrestrial animals (Ploskey 1981). The increase and bioavailability of nutrients and detritus accelerate the rate of biological productivity for periods of 5 to 10 years, which, in turn, increases the biochemical oxygen demand and depletes concentrations of dissolved oxygen. As the reservoir ages, water quality gradually improves.

The multipurpose reservoir would be very deep and would undergo thermal stratification. Stratification results when spring and summer air temperatures warm the upper layers of water (epilimnion) in the reservoir. As the epilimnion warms, it becomes less dense, and a barrier, or thermocline, develops between the cool bottom waters (hypolimnion) and the epilimnion. As a result of this density gradient, dissolved oxygen from the surface cannot diffuse to the hypolimnion. Concurrently, decomposition of organic matter in the hypolimnion exhausts residual supplies of oxygen. These anaerobic (oxygen-deficient) bottom conditions cause the release of unoxidized metals, such as iron, manganese, and phosphorus.

The process reverses in the fall. Surface temperatures cool, become more dense than the hypolimnion, and sink to the bottom, displacing the hypolimnion. This "turnover" results in mixing of epilimnion and hypolimnion, resulting in the sudden availability of nutrients which, in some cases, cause algal blooms. Most of the nutrients released from the bottom materials during summertime anaerobic conditions are taken up by organisms during the fall turnover.

As noted above, a large multipurpose reservoir could potentially enhance water quality in the lower American River by increasing the volume of cooler water released. This would, in turn, increase the concentration of dissolved oxygen. The magnitude of these benefits would depend largely on the volume of water stored for such specific purposes and the operation of the downstream releases.

Water Supply

A principal benefit of a large multipurpose reservoir would be the provision of additional water supplies. Recent estimates by Reclamation (1987) indicate that a 2.3 million acre-foot reservoir would provide long-term firm yields of between 270,000 acre-feet and 350,000 acre-feet, depending on the instream flow schedule maintained. Firm supply is

defined as water that would be available even in the most critically dry years as defined by the 7 driest years of historical record.

To put these numbers into perspective, it is estimated that a family of five in California requires approximately 1 acre-foot of water annually for domestic needs. Therefore, the firm yield from such a reservoir would support between 270,000 and 350,000 families per year. In terms of agricultural production, approximately 25 acre-feet of water per year is required for the production of food for a family of five. Therefore, if some combination of supply, demand, taxation, and/or subsidy were to make water from a multi-purpose project available to agriculture, then the firm yield from that reservoir would supply sufficient water to produce enough food to support between 10,800 and 14,000 families.

Provision of between 270,000 and 350,000 acre-feet of new water supply annually could be growth-inducing in two respects. First, additional water supplies would permit increased crop production to feed and cloth new residents, and second, new supplies could be used to meet the domestic water needs of new development.

The amount of new agricultural lands that could be put into production is a function of the specific water demands of the crop. For example, 270,000 acre-feet of water could support production of over 300,000 acres of safflower, but only 42,000 acres of rice. Table 10-2 displays typical water demands of various crops in the Sacramento region and shows the estimates for the crop-specific acreage that could be cultivated with increased water supplies.

The amount of urban development potentially accommodated by additional water supplies also varies as a function of specific land use. For example, 270,000 acre-feet of additional supply could increase urban development between 30,000 acres (high density residential) and 55,000 acres (light industry or commercial) depending on the specific land use category. In a real-time situation, supplies would be allocated to most or all potential uses, but the net effect would be that fallow or undeveloped agricultural lands could be put into production, and undeveloped and/or agricultural lands could be converted to urban uses.

Hydropower

Reclamation estimated that a 2.3 million acre-foot reservoir equipped with a 300-megawatt powerplant would generate about 600 GWh. Based on average electrical demand rates of 7,200 KWh for a typical household and 132,000 KWh for a typical commercial facility of 10,000 square feet, the power generated by the powerplant could supply the power needs for either 84,000 new homes or 4,500 new commercial facilities.

Cultural Resource

The flood-control-only reservoir would periodically inundate 17 prehistoric sites and 163 historic sites in the upper American River. The prehistoric sites are mostly bedrock

mortars, and the historic sites are associated with gold-mining activities. These impacts are described in chapter 9.

TABLE 10-2

Potential Increase in Agricultural and Urban Land Uses Based on Additional Water Supplies From a Large Auburn Reservoir[1]

	Annual Water Use (acre-feet/acre/year)	Potential Increase in Acreage
1. AGRICULTURAL		
Grain	1.4	196,429
Rice	6.5	42,308
Safflower	0.9	305,556
Sugar Beets	3.5	78,571
Field Corn	3.0	91,667
General Field	2.3	119,565
Alfalfa	4.4	62,500
Pasture	5.3	51,887
Tomato	3.1	88,710
Misc. Truck Crops	1.9	144,737
Deciduous	3.6	76,389
Vineyard	2.9	94,828
2. LAND USE		
Light Industry	5.0	55,000
Office/Business	6.2	44,355
Commercial	5.0	55,000
Rural Estate	4.5	61,111
Low Density Residential	8.7	31,609
High Density Residential	9.2	29,891

[1] Assuming yield of 275,000 acre-feet per year and would be used to meet the water needs for each crop or land use.

The large multipurpose reservoir would permanently inundate approximately 33 prehistoric and 460 known historic sites of all types and various levels of State and Federal significance. Additional consultation with the State Historic Preservation Officer and Advisory Council on Historic Preservation would be required.

GROWTH INDUCEMENT

A detailed discussion of the growth-related impacts of a multipurpose project is beyond the scope of this analysis for two principal reasons. First, the nature of the growth likely to result from an expansion project is not reasonably foreseeable at this time. Second, such an assessment would be exceedingly speculative. Nevertheless, it is clear that lack of

available water supply is a constraint to growth in the upper American River area. Expansion of the flood detention dam for multiple purposes could serve to ease this restraint. In that case, more intense development could proceed in the area. As discussed above, if a multiple-purpose project is undertaken, a full discussion of impacts, including growth-related impacts, would be required.

CHAPTER 11

COMPLIANCE WITH APPLICABLE LAWS, POLICIES, AND PLANS

The relationship of the selected plan to applicable Federal and State environmental requirements is outlined below. The project is in compliance with all laws, regulations, and executive orders.

FEDERAL REQUIREMENTS

NATIONAL HISTORIC PRESERVATION ACT OF 1966, AS AMENDED (16 U.S.C. § 470 ET SEQ.), HISTORIC AND ARCHAEOLOGICAL DATA PRESERVATION, AS AMENDED (16 U.S.C. § 469 ET SEQ.), ARCHAEOLOGICAL RESOURCES PROTECTION ACT (16 U.S.C. § 470AA ET SEQ.), PROTECTION OF HISTORIC PROPERTIES (36 CFR 800), ABANDONED SHIPWRECK ACT (43 U.S.C. § 2102 ET SEQ.)

The purpose of these acts and regulations is to protect, preserve, rehabilitate, or restore significant historical and archaeological data, objects or structures. Under these acts and regulations, Federal agencies are required to consider the effects of their undertakings on historical and archaeological resources. An agency must first identify the area potentially affected by the selected project. The agency must then inventory and evaluate the affected area to identify historical or archaeological properties that have been placed on the National Register of Historic Properties and those that the agency and the State Historic Preservation Officer (SHPO) agree are eligible for listing in the National Register. If the project is determined to have an effect on such properties, the agency must consult with the SHPO and the Advisory Council on Historic Preservation (Council) to develop alternatives or mitigation measures.

The Corps has initiated consultation with the SHPO and the Council. The SHPO and Council have concurred with the Corps that sufficient evidence exists to show that the project would adversely affect at least some significant historic properties. Therefore, the Corps, Bureau of Reclamation, non-Federal sponsor, SHPO, and Council have developed a Programmatic Agreement under which cultural resources would be further treated during the project planning, engineering and design phase, or once Congress authorizes the project. A management plan would be developed to evaluate and avoid impacts to cultural resources as project induced land changes occurred. Chapter 4 (Affected Environment) and chapters 7 through 9 (candidate plans), discuss cultural and paleontological resources and describe potential effects of the selected projects and alternatives on those resources and identify mitigation measures.

CLEAN AIR ACT (42 U.S.C. § 1857 ET SEQ. (1970), AS AMENDED AND RECODIFIED, 42 U.S.C. § 7401 ET SEQ. (SUP II 1978))

The purpose of this statute, in general, is to "protect and enhance the quality of the nation's air resources so as to promote the public health and welfare" and "to encourage and assist the development and operation of regional air pollution prevention and control programs. The Corps has coordinated with EPA (Environmental Protection Agency), California Air Resources Board, Sacramento Area Council of Governments, Sacramento County Air Quality Management District, and other Air Pollution Control Districts. The Corps' consultant, Jones & Stokes, has completed an analysis of air-quality impacts. Coordination is ongoing with EPA and the Air Resources Board to obtain a conformity determination for the project. The DSEIS/SDEIR summarizes the existing conditions and the potential impacts of the various alternatives on local and regional air quality in chapters 6 through 9. The chapters discuss issues relative to compliance with the State Implementation Plan for air quality. The requirements shall be more fully identified and developed during the engineering and design phase of the project. The Corps will be responsible for mitigation of direct impacts.

CLEAN WATER ACT (33 U.S.C. § 1251 ET SEQ. (1976 & SUPP II 1978)

The objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Section 404(b) of the Clean Water Act, as amended, requires an evaluation of impacts from the discharge of dredged or fill material into the waters of the United States and associated wetlands in order to make specified determinations and findings. For the proposed action, an evaluation as specified in Section 404(b) (1) has been included in this report as appendix I. When the feasibility report and SEIS are submitted to Congress, this procedure will satisfy Section 404(r) in lieu of issuing a public notice and obtaining a State of California water quality certificate. The findings of the Section 404(b) (1) evaluation indicate that the proposed placement of fill complies with the objective of the act.

ENDANGERED SPECIES ACT (16 U.S.C. § 1531 ET SEQ.)

The general purpose of this statute is to conserve and protect threatened and endangered species of fish, wildlife, and plants. Section 7 of the Act requires Federal agencies, in consultation with the Secretary of the Interior and Secretary of Commerce, to ensure that their actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of these species.

A list of threatened and endangered species relating to this project was obtained from the Fish and Wildlife Service (FWS). A biological assessment was prepared for the upper American River area indicating that only the threatened valley elderberry longhorn beetle is likely to be adversely affected. Mitigation features have been included in the project plan. The features include elderberry shrub plantings in the South Fork of the American River. The FWS provided its biological opinion in a letter dated November, 27, 1991, concurring in the Corps mitigation plans and found that the project will not jeopardize the continued existence of the threatened species. The FWS specified four mitigation features, nine incidental take provisions, and two conservation recommendations; all have been included in the project plan to be implemented.

A biological assessment for the lower portions of the study area was conducted in July 1995. This assessment concluded that the threatened valley elderberry longhorn beetle may be adversely affected due to construction activity associated with the Stepped Release Plan. The biological assessment was sent to FWS on July 7, 1995, and to NMFS on July 10, 1995.

Due to the recent listing of the Delta smelt as a threatened species, the Corps has prepared a biological assessment for the project. The Corps has concluded that the candidate plans would not affect Delta smelt. The biological assessment has been forwarded to FWS.

Chapters 6 through 9 of the DSEIS/SDEIR provide a detailed discussion of issues related to endangered and threatened species.

FEDERAL WATER PROJECT RECREATION ACT (16 U.S.C. § 460L-5, 460L-12, ET SEQ.)

This act requires Federal projects to consider features which would lead to enhancement of recreational opportunities. As local sponsors, the City and County of Sacramento would cost share the development of recreation opportunities associated with the project. Under the Detention Dam Plan, the existing or "historic" portion of Highway 49 would be left intact to provide recreation access to the river; the local sponsor would be responsible for this nonproject, recreational feature.

FISH AND WILDLIFE COORDINATION ACT (16 U.S.C. § 661 ET SEQ.)

The U.S. Fish and Wildlife Service has provided a Revised Draft Supplemental Fish and Wildlife Coordination Act Report that recommends compensation for project impacts. Upon conclusion of formal endangered species consultation under the Endangered Species Act, a Final Supplemental Fish and Wildlife Coordination Act Report will be provided as specified in section 2(b) of the Fish and Wildlife Coordination Act. Upon receipt of the Final Supplemental Fish and Wildlife Coordination Act Report, a supplemental report describing the results of the endangered species consultation on this project will be provided

to the public. The current status of the consultation being conducted pursuant to Section 7 of the Endangered Species Act is described in Chapter 1.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) (42 U.S.C. § 4321 ET SEQ.)

This act requires the full disclosure of the environmental impacts, alternatives, potential mitigation, and environmental compliance procedures of the selected project. This SEIS/EIR provides partial NEPA compliance. The Final SEIS/EIR and the ROD (Record of Decision) will complete the environmental documentation required by the act.

WILD AND SCENIC RIVERS ACT (16 U.S.C. § 1271 ET SEQ.), PRESIDENT'S ENVIRONMENTAL MESSAGE OF AUGUST 1979, AND COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) MEMORANDUM OF AUGUST 10, 1980, FOR HEADS OF AGENCIES

The purpose of the Wild and Scenic Rivers Act is to preserve and protect wild and scenic rivers and immediate environments for the benefit of present and future generations. Portions of both the upper and lower American River areas are designated as Wild and Scenic Rivers. The SEIS/EIR discusses these areas and considers the impacts to these portions in chapters 7 through 9.

EXECUTIVE ORDER 11988, FLOOD PLAIN MANAGEMENT

This Executive order requires the Corps to provide leadership and take action to (1) avoid development in the base (100-year) flood plain (unless such development is the only practicable alternative); (2) reduce the hazards and risk associated with floods; (3) minimize the impact of floods on human safety, health, and welfare; and (4) restore and preserve the natural and beneficial values of the base flood plain.

In this regard, the policy of the Corps is to formulate projects which, to the extent possible, avoid or minimize adverse impacts associated with use of the base flood plain and avoid inducing development in the base flood plain unless there is no practicable alternative. The flood control plans identified are in compliance with this Executive Order.

EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

This order directs the Corps to provide leadership and take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in implementing civil works. Before Federal agencies undertake any new construction in wetlands, the Executive Order requires that they must:

- Determine whether a practicable alternative exists (if so, action should not be undertaken in wetlands).

- Include practical measures to minimize harm to wetlands if action must be taken.

- Preserve and enhance the natural and beneficial values of the wetlands.

- Involve the public early in the decisionmaking process for any action involving new construction in wetlands.

The Corps has coordinated with FWS and EPA in its efforts to identify the areas of least impact when the selected project is identified and to mitigate for any unavoidable losses. Appendix I provides the Section 404(b)(1) evaluation. Further discussion regarding impacts and mitigation is contained in chapters 7 though 9.

FARMLAND PROTECTION POLICY ACT (7 U.S.C. § 4201 ET SEQ.)

This act requires a Federal agency to consider the effects of its actions and programs on the Nation's farmlands. The Corps provided the NRCS (U.S. Natural Resources Conservation Service—formerly Soil Conservation Service) with project maps and descriptions to assess impacts on prime and unique farmlands. The NRCS completed its analysis and responded with a Farmland Conversion Impact Rating letter, which is included in the technical appendixes. Further discussion is found in chapters 7 though 9 (candidate plans).

STATE LAWS, REGULATIONS, AND POLICIES

This section discusses the relationship of the selected plan to applicable California environmental requirements. Many of the requirements listed below were identified by the Office of Planning and Research as potential project clearance points (Nunenkamp, November 1990). Others were obtained via personal communication with agency personnel.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

The Legislature enacted the California Environmental Quality Act, or "CEQA," in 1970, one year after Congress enacted its predecessor statute, the National Environmental Policy Act, or "NEPA." Like the Federal act, CEQA was conceived primarily as a means to force public agency decisionmakers to document and consider the environmental implication os their actions. This document will be adopted as a joint EIS/EIR and will fully comply with NEPA and CEQA requirements. However, the State anticipates the eventual need for

supplemental environmental analysis to determine specific environmental effects relative to relocating Highway 49.

The relocation analyses will meet CEQA requirements, which specifically authorize the use of staged or tiered environmental analyses. The lead agency for preparation of the subsequent environmental documentation will be determined by either the California Legislature or CEQA Guidelines. Any route change of Highway 49 must be approved either by the Legislature or the California Transportation Commission.

RECLAMATION BOARD

As the State lead agency and one of the local sponsors of the American River Watershed Investigation, the Department of Water Resources/The Reclamation Board has primary responsibility for the CEQA review process and project review.

The Board maintains jurisdiction over all flood control work constructed with funds from Federal-State cost-sharing agreements in the Central Valley. Generally, jurisdiction extends from a point 10 feet landward of the levee across to a point 10 feet landward on the other side and includes all portions of the levee and riverbed. Also under the Board's jurisdiction are "designated floodways," including all bypasses and weirs.

Permits or Approvals Required

The Board requires an encroachment permit for any activity along or near Federal flood control project levees and floodways or in Board-designated floodways to ensure that proposed local actions or projects do not impair the integrity of existing flood control systems to withstand flood conditions.

Encroachment permit applications are evaluated according to criteria in designated floodway plans and the Board's "Standards for Encroachment." Applications are not reviewed until all necessary environmental review is completed, at which time the Board has the discretion to approve or deny an application. Permit decisions are usually made administratively unless the proposed project is very large or is contested.

The Board has determined that, as currently defined, the selected plan will require no encroachment permits.

DEPARTMENT OF WATER RESOURCES, DIVISION OF SAFETY OF DAMS

As the responsible agency for ensuring the safety of non-Federal dams and reservoirs, DWR's dam safety division approves plans and specifications to construct dams and

reservoirs after completion of the appropriate environmental documentation and review process.

DWR's jurisdiction extends to artificial barriers impounding or diverting waters that would be (1) capable of impounding at least 50 acre-feet of water or (2) at least 25 feet high (measured from the bed of the watercourse at the downstream toe of the barrier to the maximum water storage elevation for natural stream channels and from the lowest outside elevation to the maximum water storage elevation for barriers not constructed across stream channels).

Permits or Approvals Required

During design and construction of the project, the Corps would coordinate with the DSOD (State of California Division of Safety of Dams). Under the Water Resources Development Act of 1986, the detention dam, upon completion, would be under the jurisdiction of DSOD. Before the non-Federal sponsors could operate the detention dam, a Certificate of Approval would be required. DSOD would have to be satisfied that geotechnical exploration, design, and construction are adequate. The Corps South Pacific Division Regulation 1110-1-7 and DSOD Procedure No. 3-4 cover the coordination.

STATE WATER RESOURCES CONTROL BOARD, DIVISION OF WATER QUALITY, AND THE CALIFORNIA REGIONAL QUALITY CONTROL BOARD, CENTRAL VALLEY REGION

The SWRCB and the CRWQCB for the Central Valley Region review activities that affect water quality in the Central Valley. The Boards administer the requirements mandated by State and Federal law (Clean Water Act). The RWQCB establishes water-quality standards and reviews individual projects for compliance with the standards.

Permits or Approvals Required

The type of permit or approval issued depends upon the nature of the waste discharge. Normally, construction activities associated with the selected plan would require a certificate or waiver denoting compliance with the adopted water-quality standards. However, it is proposed that the congressional authorization of any of the candidate plans include an exemption from such regulation pursuant to Section 404(r) of the Clean Water Act.

STATE WATER RESOURCES CONTROL BOARD, DIVISION OF WATER RIGHTS

This agency issues permits and licenses for the appropriation of water resulting from storage or diversion. The appropriation must be related to a beneficial use.

Permits or Approvals Required

The candidate plans are solely flood control projects. All the floodflows will be passed through the proposed dam or the existing Folsom Dam and not result in an appropriation. No water rights approvals will be required.

CALIFORNIA DEPARTMENT OF FISH AND GAME, REGION 2

Generally, the DFG administers the State laws providing protection of fish and wildlife resources. DFG administers the California Endangered Species Act of 1984. This requires State lead agencies to prepare biological assessments if a project may adversely affect one or more State-listed endangered species.

Permits or Approvals Required

The DFG requires a Stream Alteration Agreement for any activity that will change the natural state of any lake, river, or stream in California. The agreements are issued by the DFG's regional offices and are intended to minimize impacts, protect fish and wildlife habitat, and ensure the best operation practices (for example, erosion control and revegetation). Since any of the candidate plans will be a Federal project authorized by Congress, there is no need to obtain a Stream Alteration Agreement. However, protection of fish and wildlife resources will continue to be coordinated with DFG.

The Board, as the non-Federal project sponsor, has initiated consultation with DFG as required under the State Endangered Species Act. If necessary, DFG may authorize incidental take in conjunction with a project mitigation or habitat conservation plan, which could allow for the loss of some identified endangered species in a project area if the mitigation plan is determined to be beneficial for the endangered species population as a whole.

STATE MINING AND GEOLOGY BOARD

The State Mining and Geology Board oversees the implementation of pertinent State laws and regulations. One of the laws within its jurisdiction is the Surface Mining and Reclamation Act of 1975 (Public Resources Code, Div. 2, Chapter 9, Sec. 2710, et seq.).

Permits or Approvals Required

The Surface Mining and Reclamation Act (SMARA) requires that an entity seeking to conduct a surface-mining operation obtain a permit from, and submit a reclamation plan to, the SMARA lead agency overseeing that operation. To be adequate, the reclamation plan must contain all categories of information specified in the SMARA. A lead agency's finding

can be appealed to the State Mining and Geology Board. The Detention Dam Plan involves two types of activities which might potentially be classified as surface mining: the extraction of (1) aggregate for use in a flood control dam and (2) borrow material for use in levee modification and construction. The DWR/The Board will coordinate with the Department of Conservation regarding any necessary reclamation plan.

STATE HISTORIC PRESERVATION OFFICE

Permits or Approvals Required

To ensure compliance with Section 106 of the National Historic Preservation Act of 1966, the Corps and non-Federal sponsors have entered into a Programmatic Agreement with the State Historic Preservation Officer. The agreement describes the work which will be accomplished to document significant resources and avoid or mitigate damages. Details on the Programmatic Agreement for the Detention Dam Plan are discussed in chapter 9, Cultural Resources of the 1991 American River Watershed Investigation Feasibility Report (EIS/EIR).

STATE LANDS COMMISSION

In addition to such State-owned lands as parks and State highways, the State Lands Commission has exclusive jurisdiction over all ungranted tidelands and submerged lands owned by the State and the beds of navigable rivers, sloughs, and lakes (Public Resources Code, Section 6301). State ownership extends to lands lying below the ordinary high-water mark of tidal waterways and below the low-water mark of nontidal waterways (Civil Code, Section 830). The area between the ordinary high and low water on nontidal waterways is subject to a "public trust easement."

Permits or Approvals Required

A project cannot use these State lands unless a lease is first obtained from the State Lands Commission. Such projects as bridges, transmission lines, and pipelines fall into this category. The Commission also issues separate permits for dredging. The Detention Dam Plan would involve the construction or modification of several bridges. The Reclamation Board would obtain any necessary lease from the State Lands Commission.

CALIFORNIA DEPARTMENT OF PARKS AND RECREATION, ACQUISITIONS DIVISION

The California Department of Parks and Recreation currently has an interim agreement with Reclamation for management and operation of recreation activities associated

with the completion of a multipurpose dam project at Auburn. The candidate plans have no impact on continuing this activity.

Permits or Approvals Required

None.

CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS), DISTRICT 3

Caltrans is responsible for ensuring the safety and integrity of the State of California's highway system.

Permits or Approvals Required

The non-Federal sponsors would coordinate the relocation of Highway 49 with Caltrans. Under California law, any relocation or realignment of a State highway must be approved by the California Transportation Commission. In accord with State law and procedures, the State agencies will likely pursue a Route Adoption Study, usually conducted by or under the supervision of Caltrans. The Transportation Commission reviews the Route Adoption Study and an environmental assessment of all alternatives. The DSEIS/SDEIR acknowledges this likely study and further environmental analysis.

In addition, any project involving the placement of encroachments within, under, or over a State highway right-of-way must be covered by an Encroachment Permit.

REVIEWING AGENCIES

Reviewing agencies evaluate proposed development plans for consistency with adopted standards and plans and may make recommendations on site improvements, required infrastructure, or mitigation which would be required of the project developer. These agencies also review and comment on the EIR prepared by the lead agency. The agencies which will review this DSEIS/SDEIR are listed in chapter 13.

NATIVE AMERICAN HERITAGE COMMISSION

The Commission reviews projects and comments on potential impacts to Native American archeological resources. The Commission is directly involved with a procedure if Native American artifacts or remains are discovered during construction activities.

CALIFORNIA HIGHWAY PATROL, LONG-RANGE PLANNING AND PLANNING AND ANALYSIS SECTIONS

The California Highway Patrol, which reviews the safety of ingress/egress from a project in relation to State highways, may comment on the realignment of Highway 49 and suggest mitigation to improve safety concerns. The non-Federal sponsors will consult with the Highway Patrol as necessary during the implementation of the proposed project after authorization.

LOCAL PLANS AND POLICIES

This section discusses the degree to which individual project components comply with locally adopted plans and policies and the factors which can complicate the process of evaluating the level of compliance. Among these factors are:

- **The intentionally broad and unspecific goals articulated in local General Plans.** California's General Plan Guidelines (California Office of Planning and Research, 1990, p. 16) state that "a goal is a general expression of community values and, therefore, is abstract in nature." Although general policies, according to the Guidelines, are supposed to be more specific, they often are not specific enough to determine compliance.

- **The potential of the candidate plans to influence the location, density, and rate of development in ways that differ from existing local plans and policies.** The plans could stimulate an increase in the number of development applications submitted to the local planning department, which in turn could result in a higher approval rate, ultimately forcing a reevaluation or change in the General Plan. Clear cases of noncompliance with the General Plan, however, occur only when a local jurisdiction continues to approve projects that violate general plan policies but does not appropriately revise the plan, as required by California Government Code, Section 65000. It is assumed that local jurisdictions would either conform to previously approved plans and policies or amend them as necessary. Thus, the potential for the candidate plans to facilitate growth would not compromise locally adopted plans or policies.

- **The currency of local plans.** Not all local plans are up to date. Sacramento and El Dorado Counties, for example, are in the process of revising their plans, and Sutter County is considering a general plan amendment which would affect land uses in the Natomas basin. Often, the presence of one or more of these situations makes difficult a determination of whether compliance will be achieved. In such cases, a finding of potential noncompliance would be reached. The non-Federal sponsors will

coordinate with local governments as necessary during the implementation of the proposed project after authorization.

FLOOD CONTROL DAM AND HIGHWAY 49 REPLACEMENT

The damsite, which was also the site of the Reclamation's proposed multipurpose dam, straddles the border between Placer and El Dorado Counties. A detention dam would require relocation of the Highway 49 bridge above the maximum flood control pool.

In the Auburn Area General Plan, Placer County and the City of Auburn recognize and accommodate the construction of an Auburn Dam (Placer County, 1978, pages 5 and 46).

The El Dorado County Long Range Land Use Plan, which is now being updated, does not mention a possible dam at Auburn. The update will assume that no dam will be constructed at Auburn and that Highway 49 will not be realigned. According to a recently released draft update, "there are numerous environmental and political obstacles to overcome before the project could be realized" [this refers to the Bureau of Reclamation's multiple-purpose reservoir project] (Sedway Cooke Associates, December 1990, p. 10). The proposed plan update also states that realignment of Highway 49 would probably necessitate a further plan update.

The Cool-Pilot Hill Area Plan, which is also being updated, refers to the Auburn Dam Project and states that approval of an Auburn Dam Project or Highway 49 bridge alignment would initiate a reassessment of the area plan to determine "probable impacts and appropriate solutions" (El Dorado County Planning Department, 1982, p. 5).

Direct Impacts

Relocating the Highway 49 bridge to pass above the maximum flood pool would entail no direct impacts that did not comply with local plans and policies. To avoid the impacts of inundating Highway 49, the selected plan includes replacing the highway above the maximum elevation of the detention pool created by the flood detention dam. As proposed, that portion of the highway would be relocated to follow the existing alignment as closely as the canyon topography allows and would be designed to current standards as a two-lane road. No allowances are made for expected future traffic. Under Federal law, the non-Federal sponsor of the project is responsible for carrying out this replacement. These impacts would include temporary increases in air pollutant emissions, noise levels, disruption of local transportation routes, and potential water-quality concerns. These impacts would occur during the construction phase and could result in short-term significant impacts. The relative level of impact is dependent on the proximity of sensitive uses to the construction sites and the number of transportation facilities disrupted.

Indirect Impacts

As designed, the new bridge and roadway would have the same capacity as the existing facilities and would not significantly improve access to northwestern El Dorado County and stimulate growth in that area. The Detention Dam Plan would therefore have no indirect impacts that did not comply with existing and proposed local plans and policies.

If subsequent State route adoption studies resulted in approval of an alternate alignment that decreased travel times between Auburn and northwestern El Dorado County, mitigation plans for the impacts associated with that alignment would be formulated at that time. As proposed, implementation of the Folsom Modification Plan or the Stepped Release Plan would have no indirect impacts that do not comply with existing and proposed local plans and policies.

OTHER LOCAL PLANS AND POLICIES

AIR POLLUTION CONTROL DISTRICTS

The candidate plans construction-related activities potentially fall under the jurisdiction of El Dorado, Placer, and Yolo County Air Pollution Control District and the SMAMD, which would determine whether project emission sources and levels significantly affected air quality, based on Federal standards promulgated by EPA and the CARB. The districts would first issue a permit to construct, followed by a permit to operate, which would be evaluated to determine whether all facilities had been constructed in accordance with the authority-to-construct permit. The districts would also determine whether applicants complied with district rules and regulations while operating the facility.

PUBLIC WORKS AND TRANSPORTATION DEPARTMENTS

All proposed activity involving the placement of encroachments within, under, or over county or city road rights-of-way must be covered by an Encroachment Permit. The following local agencies will be consulted by the non-Federal sponsor of the proposed project where appropriate: El Dorado County Department of Transportation; Placer County Public Works Department; Sacramento County Public Works Department, Encroachment and Transportation Permits; Sacramento City Public Works Department; and Yolo County Public Works Department.

LOCAL PARK DISTRICTS

A project which encroaches on a city or county park may require an encroachment permit from the local park district. The non-Federal project sponsors will obtain this if necessary.

OTHER

Other agreements from local jurisdictions may also be required to provide public services, such as law enforcement, during the construction and operational stages of the facilities. The non-Federal project sponsors will obtain such agreements if necessary.

CHAPTER 12

LIST OF PREPARERS

CORPS OF ENGINEERS AND CONTRACTORS

Name/Expertise	Experience	Role in Preparing SEIS
Lisa Clay Attorney	9 years, legal counsel, Sacramento District	Compliance with applicable Federal laws
Lee Foster Archeologist	4 years, cultural resources management, Sacramento District	Cultural resources impact identification, coordination, and description
Sue Fry Biological Science Environmental Manager	4 years, environmental studies, Sacramento District	Endangered species and air-quality analyses, biological data report, and Comment/Response appendix
Jeffrey W. Groska Biological Science Study Manager	11 years, planning and environmental studies, Sacramento District; 8 years, Detroit District	Study manager, formulation of alternatives, primary responsibility for Supplemental Information Report
Richard Johnson Civil Engineer	6 years, civil engineering, Sacramento District; 11 years, Bureau of Reclamation	Project engineer for designs and cost estimates
Jones & Stokes Associates, Incorporated	25 years Environmental Planning and Natural Resources Sciences	Technical assistance in Folsom Reoperation analysis, endangered species, air quality, fisheries, recreation, and Comment/Response appendix

Name/Expertise	Experience	Role in Preparing SEIS
Alicia Kirchner Social Science Environmental Manager	4 years, engineering technician, planning studies, 2 years, environmental studies, Sacramento District	Analyses of visual resources, agriculture, prime and unique farmlands
Wallace Lam	3 years, civil engineering, Sacramento District	Civil engineer for designs and cost estimates
Tom Meagher Civil Engineer	3 years, planning studies, Sacramento District. 6 years environmental engineers DOI.	Plan formulation, Folsom Reservoir Reoperation
Rick Meredith	Fugro West, Inc.	Consultant on incremental analysis for mitigation in canyon area
Elena Nilsson Archeologist	Dames & Moore	Consultant on cultural resource impacts
Mike Welsh Biologist, Environmental Resource Planner	12 years, environmental studies, Sacramento District; 9 years, Savannah District	EIS coordinator; analyses of water quality, hazardous and toxic waste, and cumulative impacts; environmental commitments; incremental analysis for mitigation in canyon area; 404(b)(1) analysis
Mike Wolford Biological Science Environmental Manager	5 years, environmental studies, 14 years, resource management, Sacramento District	Analyses of fish, vegetation, wildlife, and recreation; restoration opportunities; incremental analysis for mitigation along lower American River

NON-FEDERAL SPONSORS

Name/Expertise	Experience	Role in Preparing SEIR
Annalena Bronson Environmental Specialist	14 years, environmental resources planning, DWR and Reclamation Board	Report preparation and review
Duane Cornett Environmental Specialist	5 years, environmental compliance planning, DWR; 5 years, Federal natural resources management planning	Report preparation and review
Toccoy Dudley Geologist, Engineering Geologist	19 years, engineering geology for planning, design, and construction, DWR	Soil stability analysis for inundation zone
Wendy Halverson Environmental Specialist	14 years, project environmental planning and review, DWR and Reclamation Board	Report preparation and review
Jeffrey Hart, Ph.D. Resource and Landscape Ecologist	Jeffrey Hart & Associates	Consultant to SAFCA on habitat survey for lower American River
Dave Martinez Resource Planner	Dave Martinez & Associates	Consultant to SAFCA on recreation for lower American River
Ricardo Pineda Chief Engineer The Reclamation Board	DWR	Report review
Ward Tabor Reclamation Board Legal Counsel	6 years, environmental law practice, DWR; 2 years, U.S. Dept. of Justice	Report preparation and review
Tim Washburn Attorney	SAFCA	Report preparation and review

CHAPTER 13

PUBLIC INVOLVEMENT

Numerous government agencies, organizations, special-interest groups, and individuals have participated in the reevaluation of flood protection alternatives for Sacramento. This chapter describes public involvement for the reevaluation, including scoping activities, the agencies and organizations consulted during preparation of the DSEIS/SDEIR, and comments on the DSEIS/SDEIR.

An executive committee was established in 1994 to review the progress of the reevaluation studies and to help ensure a successful process for selecting a flood protection plan. The committee is made up of representatives of the cost-sharing partners in a flood protection project and other interests that would be significantly affected by a project. The committee members are:

- Colonel John Reese, Sacramento District Engineer, Corps of Engineers
- Mr. Roger Patterson, Mid-Pacific Regional Director, U.S. Bureau of Reclamation
- Ms. Deanna Wieman, Director of Office of External Affairs, U.S. Environmental Protection Agency
- Mr. Joel Medlin, Field Supervisor, U.S. Fish and Wildlife Service
- Mr. William Mueller, Office of Congressman John Doolittle
- Ms. Susan McKee, Office of Congressman Vic Fazio
- Ms. Collette Johnson-Schulke, Office of Congressman Robert Matsui
- Mr. C. F. Raysbrook, Director, California Department of Fish and Game
- Mr. David Kennedy, Director, California Department of Water Resources
- Mr. Mike Stearns, President, The Reclamation Board
- Mr. John Upton, Chairman, El Dorado County Board of Supervisors
- Mr. Alex Ferreira, Chairman, Placer County Board of Supervisors
- Ms. Muriel Johnson, Chairwoman, Sacramento County Board of Supervisors
- Mr. Dave Cox, Sacramento County Board of Supervisors
- Mr. Dennis Nelson, Chairman, Sutter County Board of Supervisors
- Mr. Mike McGowan, Chairman, Yolo County Board of Supervisors
- Mr. F. I. "Butch" Hodgkins, Executive Director, Sacramento Area Flood Control Agency
- Ms. Betsy Marchand, Chairperson, Yolo-Solano Flood Control Task Force
- Mr. Bob Holderness, Mayor, City of Folsom
- Mr. Joe Serna, Jr., Mayor, City of Sacramento
- Ms. Cindy Tuttle, Mayor, City of West Sacramento

- Ms. Sara Myers, Councilwoman, City of Folsom
- Mr. David Breninger, General Manager, Placer County Water Agency
- Mr. Bill Denton, President, Reclamation District 900
- Mr. Ed Schnabel, General Manager, Sacramento Metropolitan Water Authority

A study management team has overseen the conduct and progress of the reevaluation studies and coordinated the efforts of several working groups focused on special interests or concerns. The study management team is made up of representatives from the Corps, Bureau of Reclamation, Department of Water Resources, Reclamation Board, SAFCA, Reclamation District 1000, and the American River Flood Control District. Members of this team have also served as a focal group for extensive coordination with the Environmental Protection Agency and key resources agencies, including the Fish and Wildlife Service and Department of Fish and Game.

SCOPING

Congress' direction to the Corps in 1992 to conduct the American River reevaluation required the development of additional information on various flood control measures. To help in developing this information and in identifying public concerns about area flooding and significant natural resources, the Corps, Reclamation Board, and SAFCA held a series of general forums representing all the affected and interested groups in the reevaluation process. These forums were held on June 30, 1993; November 9, 1993; and May 24, 1994. The focus of these forums was to assist the agencies in (1) screening the flood protection measures identified by Congress, (2) formulating a reasonable range of alternatives for local decision makers, and (3) ensuring a full and fair evaluation of the impacts, costs, and comparative reliability of the alternatives.

As an outgrowth of the first general forum and the need to evaluate the existing condition of the levees and river channel of the lower American River, the Lower American River Task Force was organized in January 1994. This task force is made up of 34 representatives from the flood control and environmental agencies and organizations with a special interest in the lower river. The task force has participated in the development of (1) streambank protection measures needed to ensure the reliability of the Federal levees along the lower American River, being done as part of the Corps' Sacramento River Bank Protection Project, and (2) restoration and recreation opportunities in the lower river, as part of the American River reevaluation.

In November 1994, the Corps released the Alternatives Report for the American River Watershed. The report was for the use of the Sacramento community in identifying a locally preferred plan for increasing flood protection.

In response to the Alternatives Report, SAFCA and The Reclamation Board held a series of six public workshops and hearings on the alternatives, on December 15, 1994, and January 19 and 20, and February 2, 16, and 17, 1995. The Reclamation Board and SAFCA identified the Detention Dam Plan as the preferred upstream plan and the Stepped Release Plan as the preferred downstream plan and requested the Corps to fully analyze both plans in the draft Supplemental Information Report and DSEIS/SDEIR. The Reclamation Board and SAFCA indicated their intent to select a locally preferred plan following public workshops and hearings to be held following completion of the draft. (See Appendix A, Part II, for February 24, 1995, letter from The Reclamation Board and March 10, 1995, letter from SAFCA.)

Public notices concerning preparation of the DSEIS/SDEIR (see Appendix A, Part II) were issued on:

- April 5, 1995 - Notice of intent published in the "Federal Register"

- April 14, 1995 - Joint notice of intent and notice of preparation by The Reclamation Board, SAFCA, and the Corps

- May 2, 1995 - Notice of preparation by The Reclamation Board

Throughout the reevaluation, Federal, State, and local agencies worked cooperatively to provide information to the public about flood protection alternatives and to solicit public views and concerns. In addition to the public meetings discussed above, numerous meetings, presentations, and interviews were given with the news media, government officials, environmental groups, trade and fraternal organizations, and other interests throughout the study area.

MAJOR PUBLIC ISSUES AND CONCERNS

This SEIS/SEIR describes the significant environmental impacts that likely would result from the flood protection alternatives. Listed below are major issues and concerns identified through the public scoping process, including issues identified during review of the December 1991 EIS/EIR.

The following significant areas of controversy were identified during this study:

Detention Dam Plan

- Relationship between the Detention Dam Plan and the authorized multipurpose Auburn Dam.

- The extent of environmental and recreational impacts that would result from temporary inundation during large storms and the appropriate scope of mitigation for these impacts.

- Potential impacts from sloughing in the north and middle forks of the American River during periods when the detention dam would detain water.

- Potential impacts from reservoir-induced seismicity during periods when the detention dam would detain water.

Folsom Modification Plan

- Increasing the seasonal flood space in Folsom Reservoir and concern about impacts on water and power supplies, local water availability, water quality, and recreation.

- Relatively low level of flood protection achieved and likely preclusion of other options to provide higher levels of protection and other water resource goals.

- Residual flood risk.

Stepped Release Plan

- Hydraulic impacts to area downstream from the American River due to higher objective releases.

- Continued reoperation of Folsom Dam and Reservoir and related impacts, mainly on water supply, water quality, and recreation.

- Higher objective releases to the lower American River and levee modifications necessary to accommodate those releases.

General

- The relationship between the Federal Principles and Guidelines for water resource projects adopted by Congress in 1986 and Section 404(b)(1) of the Clean Water Act, including the application of 404(b)(1) guidelines to the analysis of project alternatives and the requirements and effects of compliance with Section 404(r).

- The draft Supplemental Information Report did not identify a tentatively selected plan, nor did it designate the NED plan.

The following issue remains unresolved:

- The difference of opinion between the Corps and the FWS on appropriate strategies to mitigate project impacts in the upper American River canyon resulting from periodic inundations.

OPPORTUNITIES FOR PUBLIC INVOLVEMENT

The notice of availability for the DSEIS/SDEIR was published in the "Federal Register" on August 25, 1995. Information on public meetings and opportunities to provide comments included:

- Public meetings on the DSEIS/SDEIR were held in September and Octobr 1995. Both verbal and written comments could be provided at these meetings.

All comments received by October 10, 1995, have been incorporated into this final SEIS/EIR.

AGENCIES AND ORGANIZATIONS CONSULTED

The following agencies and organizations were consulted during preparation of the DSEIS/SDEIR:

- American River Flood Control District
- California Air Resources Board
- California Board of Equalization, Research and Statistics Division
- California Department of Boating and Waterways
- California Department of Conservation
- California Department of Fish and Game
- California Department of Forestry and Fire Protection
- California Department of General Services
- California Department of Health Services
- California Department of Parks and Recreation, American River District
- California Department of Toxic Substances Control, CEQA Tracking Center
- California Department of Transportation, District 3
- California Department of Transportation, District 10
- California Department of Transportation, Planning
- California Department of Water Resources, Division of Dam Safety
- California Department of Water Resources, Division of Planning

- California Department of Water Resources, Division of Water Rights
- California Energy Conservation and Development Commission
- California Highway Patrol, Planning and Analysis Division
- California Integrated Waste Management Board
- California Lands Commission
- California Office of Historic Preservation
- California Office of Local Assistance
- California Office of Planning and Research, Permit Assistance
- California Public Utilities Commission
- California Regional Water Quality Control Board, Central Valley Region
- California Water Resources Control Board, Division of Clean Water Programs
- California Water Resources Control Board, Division of Water Quality
- California Water Resources Control Board, Division of Water Rights
- California Water Resources Control Board, Lahonton Region 6
- California Wildlife Conservation Board
- City of Sacramento, Parks and Recreation
- City of Sacramento, Planning and Development Department
- City of Sacramento, Police Department
- City of Sacramento, Public Works Department
- City of Sacramento, Utilities Department
- El Dorado County Board of Supervisors
- El Dorado County Community and Development Department
- National Marine Fisheries Service
- Native American Heritage Commission
- Placer County Board of Supervisors
- Placer County Planning Department
- Sacramento Area Council of Governments
- Sacramento Board of Realtors
- Sacramento County Board of Supervisors
- Sacramento County Fire Department
- Sacramento County Parks and Recreation
- Sacramento County Public Works
- Sacramento County Redevelopment Agency and Housing Authority
- Sacramento Municipal Airport, Department of Planning and Development
- Solano County Board of Supervisors
- Sutter County Board of Supervisors
- Sutter County Planning Department
- Tahoe Regional Planning
- U.S. Bureau of Land Management, Folsom Resource Area Office
- U.S. Bureau of Reclamation, Central Valley Operations Coordinating Office
- U.S. Bureau of Reclamation, North-Central California Area Office
- U.S. Environmental Protection Agency, Office of Federal Activities
- U.S. Fish and Wildlife Service

- U.S. Forest Service, El Dorado National Forest
- U.S. Forest Service, Tahoe National Forest
- U.S. Natural Resources Conservation Service
- Yolo County Board of Supervisors

COMMENTS ON DSEIS/SDEIR

The public comment period on the DSEIS/SDEIR extended from the release of the report on August 15, 1995, to October 10, 1995. Between September 12 and October 2, The Reclamation Board, SAFCA, and the Corps held six public information open houses and four public hearings. The purpose of these meetings was to present to the community the candidate plans for flood protection for Sacramento and to receive public comments on them.

Following the public review, The Reclamation Board and the SAFCA Board of Directors met separately to select the locally preferred plan for the American River Watershed Project. On October 12, The Reclamation Board adopted Resolution No. 95-17, which recommended that the Corps pursue congressional authorization of the Detention Dam Plan. On November 9, SAFCA adopted Resolution No. 95-123, which identified the Detention Dam Plan as the locally preferred alternative. (These resolutions are included in Appendix A, Part II.)

During the public review, the Corps received approximately 2,250 letters on the draft Supplemental Information Report and DSEIS/SDEIR. A total of 183 individuals provided testimony at one of four formal hearings. The comments received and responses to them are in the Comments and Responses Appendix (M). This final SEIS/EIR reflects changes made to respond to public comments received on the DSEIS/DSEIR.

CHAPTER 14

INTENDED USES OF FINAL SEIS/EIR

INTRODUCTION

This chapter explains how the final SEIS/EIR will be used to present the array of alternatives and their impacts to the decisionmakers at the Federal, State, and local levels, regulatory agencies, concerned organizations, and members of the public.

BACKGROUND

In November 1991, the Corps of Engineers completed an Environmental Impact Statement/Environmental Impact Report pursuant to CEQ (Council on Environmental Quality) regulations for implementing NEPA procedural provisions [40 CFR 1502.4, 1508.18, and 1508.28]. The Department of Water Resources and The Reclamation Board, as the State lead agencies for the study, prepared an environmental impact report, pursuant to CEQA [Section 21200]. This document was prepared to satisfy both Federal and State environmental reporting requirements, pursuant to Section 40 CFR 1506.2(b) of NEPA implementation regulations and Section 21083.5 of CEQA.

CEQA EIR content requirements differ somewhat from those required for an EIS under NEPA by requiring analysis of growth-inducing impacts, a discussion of feasible mitigation measures, and additional public noticing requirements (Remy et al., 1991). Additionally, NEPA requires that all alternatives be analyzed equally and compared (Bass, undated). To fully comply with Federal and State requirements, all mandatory elements are included in this joint SEIS/EIR.

The Corps completed a reconnaissance study in January 1988. The study concluded that (1) serious flood problems confront the Sacramento area, (2) economically feasible solutions are available to resolve these problems, and (3) a feasibility-level investigation was warranted. Accordingly, feasibility studies were conducted for the main stem American River and Natomas. Natomas is just north of downtown Sacramento at the confluence of the lower American and Sacramento Rivers.

The purpose of the feasibility study and report was to describe the preauthorization planning studies to provide additional flood protection for the Sacramento area. The scope of studies was to define the flood risks to the Sacramento area and develop a flood protection plan for the area consistent with other study area water resource needs and opportunities.

The basic authority for the Corps to study flood protection needs in the American River basin is in Section 209 of the Flood Control Act of 1962 (Public Law 87-874, dated October 23, 1962), which authorizes studies for flood control in northern California. The Corps' authorization for its reconnaissance study and subsequent feasibility investigation was included in the Fiscal Year 1987 Appropriations Act (Public Law 99-91, dated October 30, 1996), as specified in House of Representatives Report 99-670, dated July 15, 1986. Additional study authorization was included in committee language accompanying the Fiscal Year 1988 Continuing Appropriations Act (Public Law 100-202, dated December 22, 1987).

Based on this authority, a feasibility report was completed in December 1991 which recommended construction of a flood detention dam on the North Fork American River and levee improvements to the Natomas area sufficient to provide a 200-year level of protection to Sacramento.

The feasibility report presented six "action" alternatives. Three of these would have provided protection from a 100-year flood, while the other three would have controlled 150-year, 200-year, and 400-year floods. A no-action alternative served as the baseline for evaluating the action alternatives. The Reclamation Board and SAFCA (Sacramento Area Flood Control Agency) identified the 200-year protection plan as their preferred plan, which was thus recommended in the feasibility report. The Reclamation Board and SAFCA indicated that they would be the non-Federal sponsors for construction of this plan.

SUPPLEMENTAL AUTHORIZATION AND GUIDANCE

Subsequent to completion of the feasibility report, Congress provided further guidance on the conduct of the American River study in Section 9159 of the Department of Defense Appropriations Act for FY 93. In addition, Congress authorized the Natomas features described in the feasibility report for construction. In summary, Section 9159 directed the Secretary of the Army to reevaluate the flood control project described in the feasibility report and address the following items:

- Reanalyze the flood detention dam outlet design to reduce frequent flooding of the canyon, minimize soil sloughing, and assure the safety of the dam and downstream flood control system.

- Review the features of the flood detention dam to determine if the design would preclude its safe expansion for water, power, or other purposes and to identify extra costs associated with an expansion at a later time.

- Report on other features and operational procedures that should be implemented in a coordinated flood protection plan including:

- Increased objective flows in the lower American River above the design capacity of 115,000 cubic feet per second.
- Permanent reoperation of Folsom Reservoir at different levels of increased flood storage.
- Lowering the spillway at Folsom Dam.
- Transferring flood control obligations from the Folsom Reservoir to a new flood control facility at Auburn.
- Using existing and increased flood space in the upstream reservoirs.
- Offstream storage in Deer Creek.

- Consult with, and solicit the views of, the National Academy of Engineering on the contingency assumptions, hydrological methodologies used in the preparation of the American River project, and other engineering assumptions and methodologies influencing the scope and formulation of the American River flood control alternatives.

This SEIS/EIR is an informational document. Its purpose is to inform public agency decisionmakers and the general public of the significant effects of the project. It also identifies ways to minimize significant effects and describes reasonable alternatives to the project (CEQA Guidelines, Section 15121 (a) and NEPA Regulations, Section 1502.1).

The DSEIS/SDEIR was circulated for agency and public review and comment in August 1995. Comments, and responses to those comments, have been incorporated into appendix M of the final 1 SEIS/EIR. The final SEIS/EIR will be circulated for agency and public review and comment in March 1996.

Upon completion of the review process, the final SEIS/EIR will be submitted first to the Secretary of the Army, who will issue a Record of Decision regarding the adequacy of the document and the desirability of going forward with the project. If the Secretary reaches a decision in favor of construction, the final SEIS/EIR will go to Congress, which will decide whether to authorize the project. The analyses of the EPA will be considered in the authorization process.

On the State and local levels, the document must be approved first by the Sacramento Area Flood Control Agency, which functions as a "responsible agency" (CEQA Guidelines, Section 15381) and which represents the interests of the affected city and county governments. The California Department of Water Resources and the State Reclamation Board, acting jointly as the project's "lead agency" (CEQA Guidelines, Section 15367) will then certify the environmental document and approve the project. If authorization is received on both the State and Federal levels, the project can go to construction.

Several other agencies may use the final EIS/EIR as they consider permit applications associated with the project. A preliminary list of entities from whom approvals may be required is provided in table 14-1. If the project is authorized, further (or different)

TABLE 14-1

Regulatory Permits, Licenses, and Other Entitlements

AGENCY	REGULATORY REQUIREMENT	TIMING
Department of Conservation	Reclamation Plan and Permit	Prior to any surface mining activity such as aggregate or borrow material extraction
DWR, Division of Safety of Dams	Certificate of Approval	Following final design of the flood control dam, prior to construction
Department of Fish and Game	Streambed Alteration Agreement	(Not required for Federal project.)
Department of Fish and Game	Endangered Species Take Permit	Incorporated into Endangered Species Mitigation Program, prior to project construction
State Historic Preservation Officer	Programmatic Agreement	Prior to project construction in areas of historic/cultural sensitivity
Department of Parks and Recreation	Right-of-Way Permit	Prior to activity within parklands
Department of Transportation	Encroachment Permit	Prior to any activity within DOT's right-of-way
Department of Transportation	Route Adoption Study and Route Agreement	Post-authorization changes to Highway 49 relocation element of Detention Dam Plan
Air Pollution Control Districts • El Dorado County • Placer County • Yolo-Solano County • Sacramento Metropolitan AQMD	Authority to Construct; Permit to Operate	Prior to construction and operation of any of the candidate plans

approvals may also be necessary. The agency authority and permitting or approval requirements are discussed in greater detail in chapter 11 on Compliance with Applicable Laws, Policies, and Plans.

DISTRIBUTION LIST

This section provides a list of Federal, State, regional, and local public agencies and private agencies and organizations to whom a copy of the draft DSEIS/SDEIR was sent and who will receive a copy of the final SEIS/EIR for review and comment. In addition to the regulatory agencies are agencies with special expertise or interest in evaluating environmental issues related to the project. Private agencies and organizations that may be affected by the project or that have expressed an interest in the project through the public scoping process are also included.

ELECTED OFFICIALS AND REPRESENTATIVES

Governor of California
- Honorable Pete Wilson

United States Senate
- Honorable Dianne Feinstein
- Honorable Barbara Boxer

House of Representatives
- Honorable Vic Fazio
- Honorable Robert Matsui
- Honorable John Doolittle

California Senate
- Honorable Patrick Johnston
- Honorable Leroy Greene
- Honorable Tim Leslie

California Assembly
- Honorable Barbara Alby
- Honorable Philip Isenberg
- Honorable David Knowles

UNITED STATES GOVERNMENT DEPARTMENTS AND AGENCIES

Advisory Council on Historic Preservation
Council on Environmental Quality
Department of Agriculture
- Agricultural Research Service
- Agricultural Stabilization and Conservation Service

- Forest Service
- Natural Resources Conservation Service

Department of Commerce
- Environmental Science Services Administration
- National Marine Fisheries Service
- National Oceanic and Atmospheric Administration
- National Weather Service

Department of Energy
- Division of NEPA Affairs
- Federal Energy Regulatory Commission

Department of Health and Human Services
- Center for Environmental Health
- Consumer Protection, Environmental Health Services
- Public Health Service
- Water Resources-Mosquito Control

Department of Housing and Urban Development
- Federal Housing Administration
  - Housing Development Division
  - Housing Management Division
- Urban Renewal Administration

Department of the Interior
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Reclamation
- Bureau of Mines
- Bureau of Reclamation
- Columbia Fisheries Program Office
- Fish and Wildlife Service
  - Fish and Wildlife Service, Division of Ecological Services
  - Fish and Wildlife Service, Endangered Species
- Geological Survey
- National Park Service
- Office of Environmental Project Review

Department of Labor
- Manpower Administration

Department of Transportation
- Federal Aviation Agency
- Federal Highway Administration
- Maritime Administration
- U.S. Coast Guard

Environmental Protection Agency

Federal Emergency Management Agency

Smithsonian Institution
- Bureau of American Ethnology

STATE OF CALIFORNIA GOVERNMENT AGENCIES

State of California
- Assembly Committee on Natural Resources
- Assembly Committed on Water, Parks and Wildlife
- Department of Justice
- Office of Attorney General
- Senate Committee on Natural Resources and Wildlife
- The Resources Agency
  - Department of Boating and Waterways
  - Department of Conservation
  - Department of Fish and Game
  - Department of Forestry and Fire Protection
  - Department of Water Resources
    - The Reclamation Board
    - California Water Commission
- State Clearinghouse
- State Lands Commission
- State Water Resources Control Board
  - Regional Water Quality Control Board (Region 5)

LOCAL GOVERNMENT

County Boards of Supervisors
- El Dorado County
- Placer County
- Sacramento County
- Sutter County
- Yolo County

County Air Pollution Control Districts
- El Dorado County
- Placer County
- Sacramento County
- Sutter County
- Yolo County

Central California Irrigation District
- RD 1000 American River Flood Control District
- RD 1001

SPECIAL INTEREST GROUPS

American Fisheries Society
American River Coalition
Auburn Dam Task Force
Auburn Dam Council
California Trout
California Native Plant Society
California Waterfowl Association
Defenders of Wildlife
Environmental Defense Fund
Friends of the River
National Wildlife Federation
National Audubon Society
Planning and Conservation League
Sierra Club
The Wildlife Society
The Nature Conservancy

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